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PERFORMANCE MEASUREMENT AND PERFORMANCE MANAGEMENT OF INNOVATIVE PRODUCTS

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Signed:……………………………..

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THESIS ABSTRACT

Performance Measurement and Performance Management of Innovative Products

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Increasing interest is being shown in performance measurement, in both the academic literature and by practitioners. When implementing innovative products, organisations are facing issues of how to measure and manage the performance of the products concerned and how to do so in a worthwhile way. Reviewing existing literature suggests that there has been limited research on the value of performance measurement and management processes and indeed little conceptual distinction has been made between performance measurement and performance management. A conceptual framework is developed, structured around concepts from the existing literature showing two ways of distinguishing performance measurement and performance management. Performance management processes are shown as broader than performance measurement processes and the influences of the processes on performance are also displayed, another way of differentiating between the two concepts. The framework provides a structure for a pattern matching analysis using empirical data.

Empirical data collection involved four case studies, each focusing on a medical device being implemented in the UK public healthcare sector. Forty-six semi-structured interviews explored performance measurement and performance management processes in the implementation of the innovative products, as well as exploring the influences of those processes on performance of the innovative products. The findings from the thesis highlight key performance measurement and performance management processes that occur in the implementation of innovative products, finding that the two can best be distinguished by their influence, or lack of influence, on performance. Performance reporting is also highlighted as a key concept. The findings indicate that performance measurement and reporting processes alone cannot be expected to have an influence on performance, however if performance management processes occur too then they can.

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CHAPTER ONE: INTRODUCTION TO THE THESIS

1.1. Introduction

This thesis has been developed from research into how and why organisations measure and manage the performance of innovative products which they buy and sell. There is an increasing focus in both the academic literature and practice on measuring performance. When purchasing and supplying innovative products, organisations are facing issues of how to measure and manage the performance of the products concerned and how to do so in a worthwhile way. These issues form the topic of enquiry of the thesis.

This first chapter describes the subject and context of the enquiry by way of background, then defines the fundamental problem driving the research. It describes the research aim, before providing an overview of the approach taken to the research and methodology used. Finally, the structure of the rest of the thesis is outlined.

1.2. Subject and Context of Enquiry

The subject of enquiry of the thesis draws on key issues highlighted in the existing academic literature.

Research in the area of performance has focussed on performance measurement and themes such as the appropriate selection and implementation of performance measures. Neely (1999) refers to a revolution in performance measurement which is becoming increasingly topical, driven by reasons such as the changing nature of work, organisational roles, external demands and increasing competition, particular improvement initiatives, power of information technology and quality awards. The performance literature draws on a variety of subject areas, which themselves are increasingly focussing on issues of performance measurement and management, for example in operations management (Radnor & Barnes 2007). Indeed the diverse and fragmented literature on performance measurement is seeing increasing interest as a unified subject of study, with the formation of the Performance Measurement Association for example.

Within the performance field, the research agenda is increasingly turning to whether performance measurement is worthwhile (Neely 2004, 1999). Although publications have long described appropriate performance measures (Neely 1997) and possible dysfunctional consequences of inappropriate measures (Ridgway 1956), researchers are now focussing on the influence of performance measurement on performance. Studies in this developing area have tested for quantitative links between particular measures and performance outputs, giving conflicting results (Davis & Albright 2004, Ittner *et al.* 2003a, Banker *et al.* 2000, Perera *et al.* 1997, Neely *et al.* 2004). Another key development in the performance literature is a progression to discussing not only performance measurement, but also performance management (Halachmi 2005, Radnor & Barnes 2007). A broadening of aspects of performance and unit of analysis studied has also occurred in recent research. While much existing work has researched performance measurement of the organisation amongst others, this thesis draws on the contemporary interest in evaluating the performance of products, a theme also of growing importance in the innovation literature.

Performance measurement and management have seen increasing use in the innovation literature, where the focus is on the challenges and imperative of organisations innovating successfully (Tidd *et al.* 2005 pp37-44). Innovation has been found to be a difficult process, but essential as the various types of innovation studied involve developing an innovation with a novel element, which is then exploited for benefit. Existing literature has discussed the process of innovation, which increasingly necessitates taking an inter-organisational perspective as the input of more than one organisation is required if innovation is to be successful (Chapman & Corso 2005, Ritter & Gemunden 2004, Grandori & Soda 1995).

An interaction occurs between organisations in the innovation process where the organisation that has produced an innovative product supplies it to a purchasing customer organisation in the market place. The innovation literature has examined this interaction between organisations in terms of adoption or rejection of the product during its implementation (Biemans 1992 pp42-45) and processes such as feedback of information between actors which is used to improve the product (Rothwell & Gardiner 1985). The literature has also shed light on the issue, describing how product, financial, social and informational exchange between customer and supplier occur in the interaction between organisations (IMP Group 1982, Ring & Van de Ven 1992, Wilson & Jantrania 1994) and in networks of organisations interacting in the innovation process. The literature also describes how decisions are made to adopt or reject a particular innovation (Webster & Wind 1972 pp12-39), as well as some of the factors affecting uptake of innovations (Tzokas & Saren 1992, Phillips *et al.* 2007, Edquist & Hommen 1999).

In practice, there has also been an increasing focus on managing innovation, purchasing and supply, and performance measurement and management. These issues have been emphasised in the public sector context of this research. Overall, the literature suggests that the UK public health sector has a complex network context, with many actors, activities and resources that are often decentralised (Walker *et al.* 2006). It acknowledges that the NHS is a multi-levelled, complex, dynamic organisation with many differences at the local level (Pope *et al.* 2006). Across government there is a focus on performance which is expressed through using purchasing and supply initiatives as a lever to achieve policy objectives. This is evidenced by the advent of the Office of Government Commerce and recent policies of using procurement to reduce costs or increase value (Gershon 2004 pp5-8, 35-36, Bourn 2006 pp2-11, H.M. Treasury 2007 p3) and a strong emphasis has been placed on measuring performance in such areas (Wilson 2004). Government policy has also concentrated on the importance of innovation in the context of a competitive global economy (DTI 2003 pp7-16).

Performance in purchasing of innovative products has been a key issue for the NHS, which as a buyer can constrain or enable the process of innovation and the uptake of innovative products (Phillips 2007, Edquist & Hommen 1999). The NHS as a customer has been highlighted as slow in the uptake of innovative products from the many private sector suppliers that exist in the healthcare industry (Wanless 2002 p52). That many innovations in the NHS need to be drawn from external suppliers is typical of the literature (Axelsson 1987 pp128-130), particularly where the customer organisation is so large (Bommer & Jalajas 2004). The Health Care Industries Task Force (HITF) with representatives of public and private sector was set up and made recommendations on promoting purchasing of new medical technologies and products, with benefits for industry, public health sector and patients (HITF 2004 pp5-7). A HITF recommendation was the creation of a new Centre for Evidence-based Purchasing (CEP), highlighting a focus on measuring performance as part of purchasing that was also emphasised in the recent evidence-based academic literature (Harland *et al.* 2007, Pfeffer & Sutton 2006). Table 1 summarises key UK Government policy documents for healthcare in the public sector, with implications for measuring and managing performance in the implementation of innovative products such as medical devices.

The thesis draws upon literature investigating performance and innovation topics, two developing areas of research. In particular, the literature on performance is fragmented and draws on a wide variety of other literatures, including strategic management, operations management and others such as economics. This thesis primarily uses the performance and operations literatures, as well as some publications of interest from the broader field of management.

Source	Document	Issued by	Key Content
Gershon (2004 pp5-8, 35-36)	Releasing Resources to the Front Line. Independent Review of Public Sector Efficiency	H.M. Treasury	Original Gershon Report in 1999 advocated efficiency and best value for money through purchasing. 2004 Report identified efficiency measures of £21bn to be achieved by 2008. The importance of evidence-based policy as a lever for improving performance
Bourn (2006 pp2-11)	Progress in Improving Government Efficiency	National Audit Office	Reports that progress has been made on government efficiency targets, but a reported £4.7bn savings must be considered as provisional and subject to further verification
H.M. Treasury (2007 p3)	Transforming Government Procurement	H.M. Treasury	Range of public procurement reforms so that the UK may deliver world-class public services, mainly to the OGC which is slimmed, given new powers and increased staff skills. Health service faces growing challenges of global competition, changing demographics and resource pressures
HITF (2004 pp5-7)	Better Healthcare Through Partnership: A Programme for Action	Department of Health and Association of British Healthcare Industries	Report following joint government and medical devices industry task force. Development of existing Device Evaluation Centre (DES) to new Centre for Evidence Based Purchasing (CEP) in DoH. New Innovation Centre to promote and support development of new technologies.
DTI (2003 pp7-16)	Innovation Report: Competing in the Global Economy: The Innovation Challenge	Department of Trade and Industry	Public sector spend on goods and services in areas such as healthcare has great potential to stimulate innovation by acting as intelligent consumer
Cooksey (2006 pp3-8)	A Review of UK Health Research Funding	H.M. Treasury	Independent review recommends improved coordination and coherent funding for medical research, including into medical devices

Table 1. UK Government Policy Documents of Relevance for Public Sector Healthcare.

1.3. Problem Definition

Existing research has highlighted increasingly the importance of performance measurement and performance management, whether of organisations, products or processes. However the literature in the area is fairly fragmented and still developing, giving a lack of clarity over many concepts. In particular there has been an emphasis on performance measurement and management during the purchasing and supply of innovative products. The implementation part of the innovation process focuses on the supplier turning ideas into a product reality, exploitation in launching it to the market where the customer utilises it and finally sustaining the innovation with feedback. The focus on innovation and the key activities of purchasing and supply management during the implementation of innovations is a key area of concern for organisations in practice and also for academic research, which has emphasised the imperative of taking an inter-organisational approach when studying the innovation process. As described above, a further key issue emerging in the performance literature is not just the specification of performance measures, but gaining a fuller understanding of the influence of performance measurement and management.

Drawing these issues from the existing literature together suggests that there are opportunities to investigate how the performance of innovations is measured and managed, particularly during their implementation. In particular, there is a need to carry out research analysing whether these processes are worthwhile.

In response to these issues highlighted in existing research and practice, the aim of the thesis is:

- To explore performance measurement and performance management during the implementation of innovative products, focusing on their performance effects.

Existing research has discussed selection and implementation of performance measures, however little research so far has focussed on investigating performance measurement and management in the implementation of innovative products and there is a need to focus on the influence of performance measurement and management processes, by examining how they affect the performance of the innovative product. Investigating these issues in the thesis are central in making a contribution.

The above aim is developed into research questions later in the thesis, as described below. This chapter continues by outlining the approach and research methodology used, in the next section, then stating the structure of the thesis in the following section.

1.4. Overview of Research Methodology and Approach

As described and justified in depth later in the thesis, the topic of the enquiry and research questions chosen dictated the research methodology and approach selected.

The developing nature of research in the performance area, drawing on several bodies of knowledge means that this research is largely exploratory, dictating a case study methodology as being appropriate. This is particularly useful given the complex, dynamic network context of inter-organisational innovation and purchasing and supply management (Yin 2003 p5). Multiple case studies were used to develop analytical generalisability, each of the four cases concentrating on an innovative product, the unit of analysis selected. Cases were selected from the public sector healthcare context, focussing on medical device innovative products. Again given the exploratory nature of the research and the lack of clarity over many of the concepts in the existing literature, 46 semi-structured interviews (Bryman 2004 pp109-129) were used as the key technique to gather qualitative, exploratory data. Supplementary use was made of documentary evidence and network mapping.

The case study methodology was selected based on an interpretivist (Ramsay 1998) epistemological stance, recognising the role of human actors and the social construction of knowledge. The approach does not risk the shortcomings of a positivist stance, where an objective, mechanistic event-based approach does not allow for the complex interactions and open systems found in the topic of study of this research (Outhwaite 1987 pp19-23).

The thesis has necessarily taken an iterative, theory building approach in analysing existing literature and the empirical data, which eventually produced the contribution of the work. This approach has aspects of both inductive and deductive research approaches, which has been referred to as abductive by Dubois and Gadde (2002), discussing systematic combining of theory and empirical data. As part of this abductive approach and following coding and generation of case descriptions, the thesis involved a pattern matching analytic strategy, both within and across the four cases, referring to the conceptual framework (Yin 2003 pp109-140). Matrices were used as a key tool in pattern matching (Miles & Huberman 1984 pp79-118). A key further part of the methodology describes the steps taken in the empirical work to try and ensure the reliability and validity of the research.

Having outlined the research problem, methodology and approach, the next section illustrates the structure of the rest of the thesis where full descriptions are explained.

1.5. Structure of the Thesis

This thesis document is divided into three parts and nine chapters, as illustrated in Figure 1 which also shows key connections between the parts and chapters as part of the iterative research approach. Part One gives the background to the research, introducing the thesis, critically reviewing the existing literature, then developing research questions and a conceptual framework. Part Two relates to the empirical part of the thesis, describing and justifying the selected methodology and research process, then presenting the findings from each of the four case studies, then from a cross case perspective. The third and final part discusses the empirical results with reference to existing research in the literature review, revising the conceptual framework. Part Three finishes by returning to the research questions then describing and reflecting the contribution and limitations of the thesis, with implications for future research.

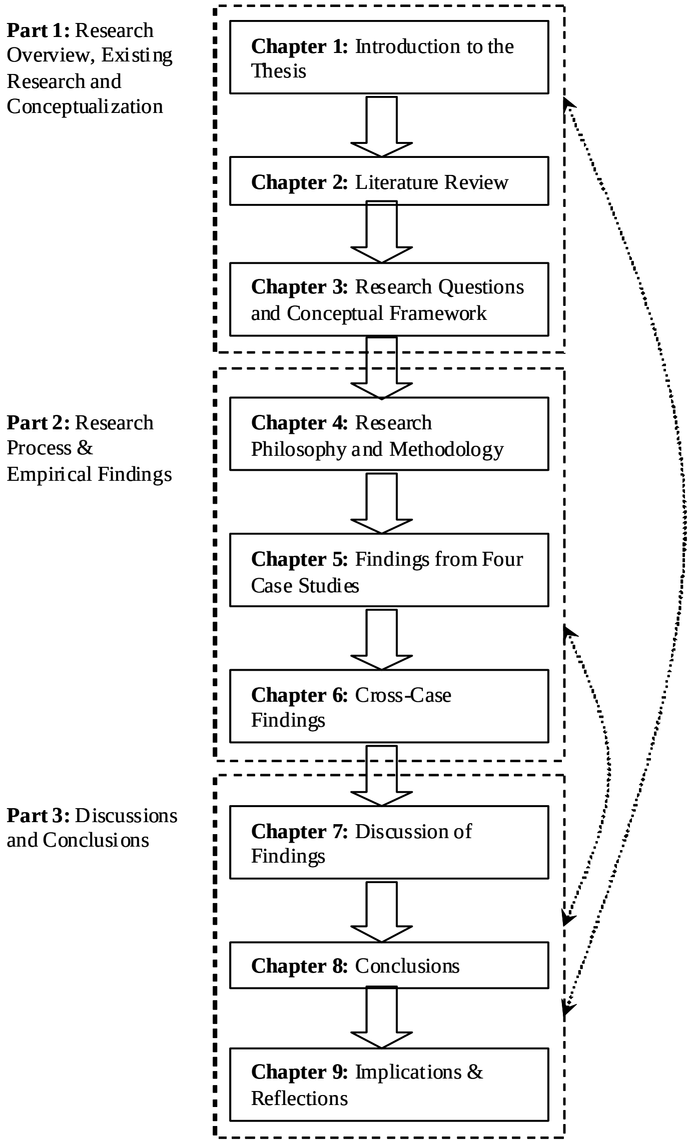

Figure 1. Structure of the Thesis

Following this first introductory chapter, Chapter Two reviews the existing literature. It sets out to define the key concepts in the topic of study and analyse the extent of existing knowledge by reviewing the work and models of key researchers, of relevance to pursuing the research aim above. The literature on performance is investigated, looking at the broad concept and different aspects of performance, then focussing on the key concepts identified of performance measurement and performance management and finally analyses the influences of performance measurement and management on performance, identified as a key frontier for research in the area. Literature describing the context of the research in the implementation of innovative products is then discussed.

Chapter Three presents, describes and justifies the research questions on the basis of the literature review. Towards development of the initial conceptual framework that underpinned the empirical work, it then analyses some key concepts involved in the research questions.

Chapter Four discusses operationalization of the empirical work through selecting, and describing the research methodology and approach. Through analysis of the various options available, the chapter justifies the selection of an interpretivist approach, abductive research design and a multiple case study methodology. It describes data collection and analysis, with a focus on issues of reliability and validity.

Chapter Five reports on the empirical findings from each of the four case studies in turn. For each innovative product case studied, it introduces the product and describes why it is innovative, also discussing the background and supply relationships and networks in the case. Each case description is structured according to the key concepts in the research questions and conceptual framework, based in turn on the literature, so performance measurement processes, performance management processes and their influences on performance are all discussed in turn.

Chapter Six presents the findings from a cross-case perspective, following the same structure as in Chapter Five for consistency. Also using tools such as matrices, it examines the similarities and differences across the four cases, giving an overview of the main findings from the case studies. In doing this key tactics for generating and confirming findings are used, such as noting patterns, replicating findings and checking out rival explanations.

Chapter Seven reports on a key part of the iterative research process, taking the empirical findings and discussing them in the context of the existing literature, using the same structure as in the previous two chapters. Some additional literature was needed to interpret the empirical findings and conceptual lessons are drawn at the end of the chapter, which are used to revise the conceptual framework.

Chapter Eight returns to the research questions, discussing how the findings of the thesis and results of the discussion in the previous chapter address the questions. This is presented by examining how the findings stand upon key publications from the existing literature.

Chapter Nine reflects on the thesis, describing the key limitations of the work and contribution, particularly with respect to validity and reliability. This leads to discussing the implications for both future research and for practice. It concludes by suggesting avenues for improving and extending the research in future, paying attention to the limitations of this research.

1.6. Summary

This chapter has illustrated the subject and context of the enquiry, leading to a definition of the research problem and development of an overall aim for the research. An overview of the research methodology and approach, along with a structure of the thesis contributes to an outline of the thesis as a whole. The thesis was inspired by academic interest in how performance measurement and management occur and in particular whether they are worthwhile. The particular field of interest concerns performance measurement and management in the purchasing and supply of innovative products, a key area of academic interest as well as for practitioners. The aim of the thesis as described above provides a basis for taking these research issues forwards and the thesis is based upon a review of existing work and empirical work carried out. The next chapter analyses existing knowledge in the key areas of literature drawn upon for this research.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The previous chapter outlined the research and described the context. This chapter investigates the existing literature, focussing on performance. Publications in the literature reviewed so far have taken an interest in the performance of concepts such as the innovation process, purchasing and supply management as a function, relationships, and innovative products. However there is also an increasing explicit interest in performance as a research topic, reflected in practice where organisations face pressure to perform increasingly well. This chapter begins by defining performance and investigating some of its key aspects from the existing literature. Performance measurement is a major theme in the performance literature and is discussed in the following section, with a focus on measuring the performance of innovative products. The next sections discuss the term performance management and relevant processes that are also found in the literature, then the influences of performance measurement and management processes. The last part of the chapter briefly outlines existing literature on the innovation process, which is necessary to understand the context of the research. Figure 2 summarises the structure and content of this literature chapter. Findings from the literature review are then used to provide a platform for conceptualization of this research in the next chapter.

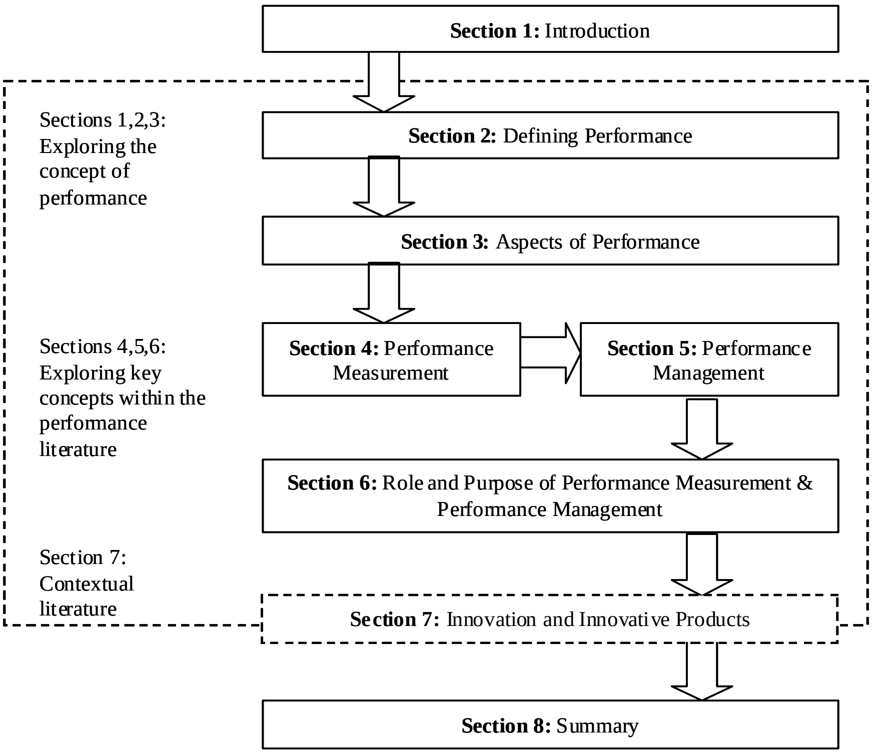

Figure 2. Structure of the Literature Chapter

2.2. Defining Performance

This section defines performance in general, discussing use of the term in the literature, the growing body of research specifically on performance and research using similar terms. The dictionary definition of performance is as follows:

1. *"the act or process of performing or carrying out"*
2. *"the execution or fulfilment (of a duty) etc"*
3. *"a person's achievement under test conditions etc"*
4. *"the return on an investment, esp. in stocks and shares etc"* (Thompson Ed. 1995 p1015)

In using words such as 'fulfilment' and 'achievement', the definition alludes to some sort of attainment or reaching of a standard in the output to a process. They suggest that a wide range of things may perform, including processes, actors or products.

2.2.1. Performance in the Literature

The term 'performance' is widely and loosely used across a range of bodies of knowledge in the literature, including strategy, operations management and innovation. As Lebas (1995) comments: *"Few people agree on what performance really means: it can mean anything from efficiency, to robustness or resistance or return on investment, or plenty of other definitions never fully specified"*. Database searches of key journals used in the review so far for publications with performance in the title reveal the term has been put to a variety of uses. Table 2 shows examples.

Research has studied the performance of manufacturing plants (Narasimhan *et al.* 2005), corporations (Melnyk *et al.* (2003), organisations (Day & Lichtenstein 2006) and business units (Morgan & Vorhies 2001). Performance of the supply chain (Paulraj *et al.* 2006), supply function (Kaufmann & Carter 2006), suppliers themselves (Millington *et al.* 2006) and relationships (O'Toole & Donaldson 2006) have been discussed. Innovation literature has studied performance of processes (Frishammar & Sven 2005), products (Langerak *et al.* 2004), their selling performance (Hultink & Atuahene-Gima 2000) and product portfolios (Cooper *et al.* 1999). Performance measurement or measures (Kennerley & Neely 2003, Kaplan & Norton 2005) and different aspects of performance (Hendricks *et al.* 2001, Kaufmann & Carter 2006) are other key performance themes in the literature, discussed later.

Journal	No. Publications with Performance in Title (10 years up to May '07, Database: Business Source Premier)	Examples of Publications and their Use of 'Performance'
International Journal of Operations & Production Management	106	• Millington *et al.* (2006): Performance of suppliers, in particular global suppliers • Narasimhan *et al.* (2005): Performance of manufacturing plants • Kennerley & Neely (2003): Measuring performance • Fynes & Voss (2002): Quality, manufacturing and business performance
Journal of Operations Management	78	• Kaufmann & Carter (2006): Supply management performance, performance outcomes of sourcing • Melnyk *et al.* (2003): Corporate and environmental performance • Hendricks & Singhal (2003): Financial performance of the organisation
Journal of Purchasing & Supply Management	11	• Paulraj *et al.* (2006): Supply chain performance • Day & Lichtenstein (2006): Organisational performance • O'Toole & Donaldson (2002): Relationship performance dimensions
Harvard Business Review	30	• Kaplan & Norton (2005): Performance measures • Kirby (2005): High performance company • Augustine *et al.* (2001): Performance of individuals
Journal of Product Innovation Management	41	• Leenders *et al.* (2007): Performance of new product teams • Frishammar & Sven (2005): Innovation performance • Langerak *et al.* (2004): New product performance, organisational performance • Morgan & Vorhies (2001): Business unit performance • Hultink & Atuahene-Gima (2000): New product selling performance • Cooper *et al.* (1999): New product portfolio performance

Table 2. Examples of Use of the Term 'Performance' in Recent Publications

Further, other existing research has studied performance in a less specific way. For example Carter and Ellram (2003) reviewed the most common research topics in *The Journal of Supply Management*. Papers on inventory and production management including forecasting, purchasing organisation and contracting including contract management and cost analysis all attempt to build theories about how organisations manage their processes or other organisations towards improving or maintaining performance in some form.

2.2.2. Similar Terms Used in the Literature

So far the literature suggests performance is a loosely used term, indeed other similar terms also appear such as 'success', 'value' and 'effectiveness'. Ritter and Gemunden (2004) built a concept of product innovation success based upon measures including an organisation having better market response to innovations compared with others. ‘Success’ is thus used in a very similar conceptual sense to performance as analyzed above, however Ritter and Gemunden (*ibid.*) give a success scale that is reverse scored: *“Our competitors have more success with their product innovations”*, demonstrating that success is a positive concept that is either present or absent, whereas performance may be positive or negative. Success has had limited use in the literature whereas performance has been used extensively in the concepts of performance measurement and performance management for example. In addition to success and the opposite concept of failure, Cooper and Kleinschmidt (1987) refer to new product winners and losers in the same publication, again suggesting that terminology is relatively loose in the field.

Value is another loosely used term found in the literature of relevance to performance. Indeed little existing research has defined what value is and how it is created (Tzokas & Saren 1999). Value stems from the concept of ‘value for money’ referring to financial and product exchanges (Anderson *et al.* 2000). Further, the strategy literature describes the value chain (Porter 1985 pp36-52) model, illustrating the various activities of an organisation that make the product or service. The value chain is also focussed on cost, interpreting the concept of value financially. Lindgreen and Wynstra (2005) reviewed the limited existing literature on value in purchasing and supply and business marketing literatures. They found that value increasingly focuses on broader costs and aspects of value than simply the purchase price, highlighting the challenge of trading off the attributes of different products (Ketchen & Hult 2007, Wouters *et al.* 2005), especially as there is limited understanding of how customers value the use of particular products (Woodruff 1997). A contrast can be drawn between value and performance, as definitions of performance refer to some form of achievement, whereas value alone does not. Effectiveness is a further similar term (Cormican & O’Sullivan 2004), used to describe particular aspects of performance.

2.2.3. Literature in the Performance Field

In addition to the various areas of knowledge that discuss performance in general, existing literature has a growing body of knowledge specifically on performance as the main research interest. Neely (1999) claims that a revolution is occurring in the field of performance measurement, suggesting that it has become a particularly important topic recently for organisations in practice, due to reasons such as increasing competition, changing demands, awards, the role of information technology and increased improvement initiatives. He points out that performance research has been spread across a range of subject areas, with very few cross-subject researchers. Some of the most overarching performance research is from the strategy field (Simons 1995, Chakravarthy 1986), given the cross-functional nature of the field. Such work concentrates upon research issues of what drives performance, as well as how performance can be measured. Peters and Waterman (1982 pp3-28) is a normative example that studied organisational performance with the aim of unravelling the answers to achieving it. Journals in more specific fields such as operations management and innovation have produced special editions on performance, examples of its rise as a research and practical issue crossing sectors. Examples of special issues include those in the *Journal of Operations Management* (Melnyk *et al.* 2004) and the *International Journal of Management Reviews* (Denyer & Neely 2004). Meanwhile the *International Journal of Productivity and Performance Management* is a key journal in the performance field, however it has origins in fields such as manufacturing with an emphasis on productivity.

Drawing on the diverse and loose body of knowledge on performance in the literature, the next section breaks down the concept of performance into various aspects to illustrate it further.

2.3. Aspects of Performance

The current section takes apart the general concept of performance by discussing different aspects found in the literature. A lot of the discussion is based upon performance measures, as they are often the manifestation of different descriptions of performance. However performance measures and the process of performance measurement are discussed in their own right in a later section. This section analyzes concepts of performance in general, towards the end of describing concepts of performance of innovative products in particular. It is of use in later discussion of the role and purpose of performance measurement and performance management.

2.3.1. Financial Aspects of Performance

Performance concepts draw on a variety of areas of research, particularly the accounting and operations management literatures (Neely 1999). The earliest concepts of performance investigated are financial and there is a substantial management accounting literature dealing with this area, focussing on concepts of profit and productivity, expressed in monetary terms (Barlev 1995, Ben-Hsien & Da-Hsien 1989). An early example from the general management literature that focuses on financial measures is Ridgway (1956) focussing upon return on investment, while later Ferguson and Leistikow (1997) discuss different quantitative economic value added concepts. Hendricks and Singhal (2003) studied the effects of supply chain glitches or problems on performance, expressed in terms of a sole financial descriptor, shareholder wealth. While they address a purchasing and supply issue, Hendricks and Singhal (*ibid.*) have produced a traditional style of research in the performance field, as it uses quantitative methods in a causal investigation and concentrates on a single financial measure and description or aspect of performance.

2.3.2. Broader Operational Aspects of Performance

As literature in the performance field has developed, research has progressed from studying solely financial performance using a single measure to studying broader, operational aspects of performance, using a greater number of measures. Ittner and Larcker (2003b) for example, suggest that organisations wish to manage broader, operational types of performance, as they think that these will eventually have an effect upon financial performance. Bull (2007) describes the value or success of an organisation in terms of efficiency, effectiveness and efficacy, highlighting an operational as well as financial focus. The Balanced Scorecard (BSC, Kaplan & Norton 1992, 2005, Holmes *et al.* 2006) has been key to this development and was created with the realization that sole use of traditional financial accounting measures from the industrial era is often inappropriate for contemporary organisations, where processes such as innovation occur. Return on investment alone is unlikely to encourage innovation for example. Cornerstones of the BSC are its balance of measures of different aspects of performance, multiple stakeholder perspective including external organisations and the way it encourages setting goals for measures (Figure 3). Innovation and learning are recognised as important by the BSC and just as the previous chapter discussed how innovation is essentially an inter-organisational process (Tidd *et al.* 2005 pp52-55), the BSC suggests that performance is of interest to and influenced by stakeholders beyond the immediate organisation.

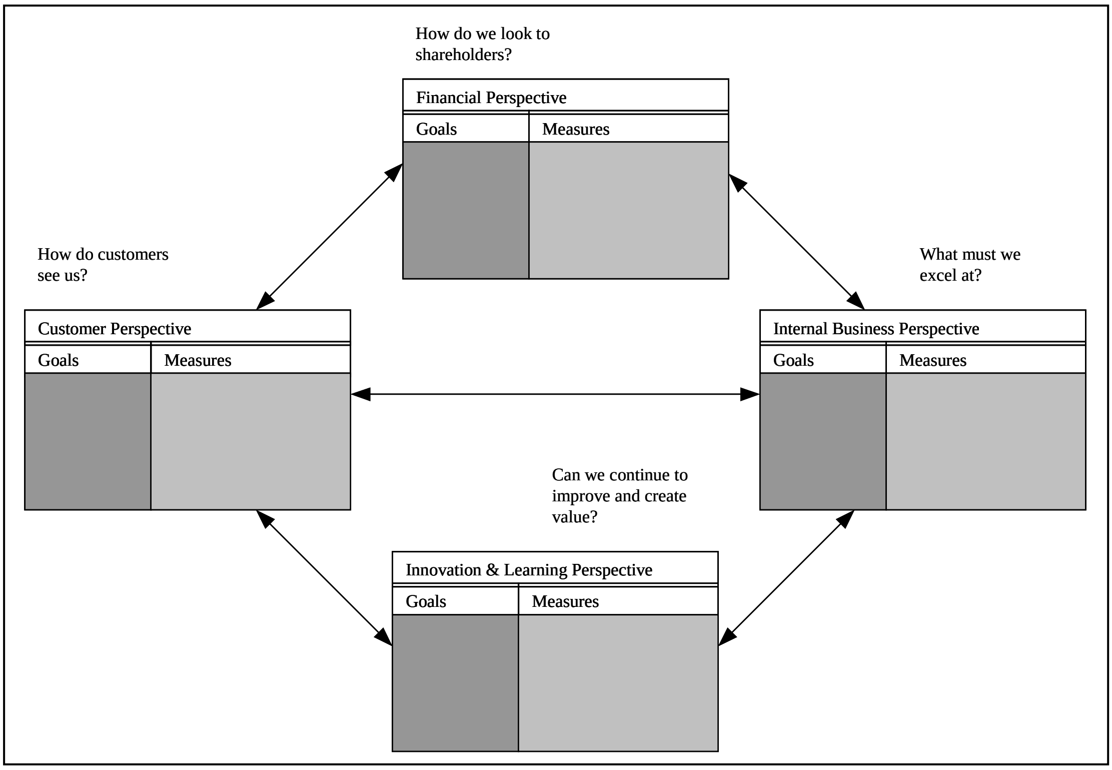

Figure 3. Conceptualization of Performance from the Balanced Scorecard. After: Kaplan R.S. & Norton D.P. 1992. The Balanced Scorecard – Measures That Drive Performance. *Harvard Business Review.* 70(1) pp71-80.

The operations management literature has focussed on a number of parameters of operational processes and the product or service produced by it, presented as ways that the process or product may perform and helping to conceptualise performance. The most commonly chosen are cost, speed and quality, often supplemented with flexibility and dependability (Slack *et al.* 2007 pp39-54). The descriptors focus on technical aspects of products or services and their production process, from the perspective of outputs for the customer. Overall though, the literature so far has highlighted that performance can be perceived differently by customers and suppliers, both internally and externally to the organisation (Chenhall & Langfield-Smith 2007). Indeed the literature conceptualises operational aspects of performance at different parts of the transformation processes (Slack *et al. ibid.* p8-16, Godwin *et al.* 1989) occurring within and between organisations, including outputs, such as delivery reliability to the customer (Slack *et al. ibid.* pp39-54), inputs such as timely delivery from suppliers (Duffy & Fearne 2004) and the transformation process, such as capacity (Graham 2005). Further, operational aspects of performance are also discussed at various levels of analysis in the literature. These include a particular innovative product (Zheng Zhou 2006), process (Bendoly & Jacobs 2004), organisation (Ritter & Gemunden 2004), dyadic relationship (Carr & Pearson 1999), supply chain (Gunasekaran *et al.* 2004) or supply network (Straub *et al.* 2004).

Focussing specifically on aspects of product performance, the value literature describes how a customer values different aspects of product performance, with the benefit of purchases for a supplier firm (Lindgreen & Wynstra 2005, Eriksson & Lofmarck-Vaghult 2000). Although value is often defined in financial terms (Yadav & Monroe 1993), the characteristics of how the product performs for the customer are increasingly included. Zeithaml (1988) suggests that value can be low price, the customer getting what they want in a product, the customer getting quality for the price they pay or the customer getting value for what they give. Similarly, Miles (1961 pp3-23) describes not only cost and exchange values of a product, but also use value depending on how the customer uses the product. Broader aspects of value are also illustrated by Lemmink *et al.*'s (1998) emotional, practical and logical dimensions. The next sub-section focuses on innovative products.

2.3.3. Performance of Innovative Products

Some aspects of performance are particularly appropriate for describing the performance of innovative products, the unit of analysis in this research. Teece (1992) focuses on financial performance of innovations in describing strategies for capturing financial benefits in the healthcare market for scanners. The broadening of performance concepts to those that describe a variety of measures, as in the BSC is particularly relevant to innovative products (Kaplan & Norton 1992) as traditional financial and accounting measures such as return on investment were more appropriate for organisations in the industrial mass production era. The innovation literature also includes descriptions of performance that are specific to innovation, as shown by Tidd *et al.* (2005 pp561-569) giving a range of measures, as compiled and presented in Table 3. Also, Table 4 summarises some more descriptions of performance from the innovation literature, breaking down the overall concept of performance of innovative products.

In common with the wider performance literature, a broad range of financial and operational measures is evident in Tables 3 and 4. The descriptions also reflect themes in the definitions of innovation, discussed in the previous chapter. For example they describe ways of measuring the performance of something new, such as number of patents and scientific papers, as well as describing exploitation, for example the percentage of sales derived from new products. The performance of both the product and the organisation is described. This point is reinforced by Hauser (1998), referring to two types of metrics in research and development, namely market outcome metrics such as the financial metrics discussed earlier, and those metrics that measure research effort more directly such as patents and citations.

Type of Measure / Description of Performance	Examples
Input Measures	• Percentage of sales committed to research & development • Investments in training • Recruitment of technically skilled staff
Output Measures	• Specific output measures: no. patents, no. scientific papers, no. new products introduced, % sales or profits derived from new products introduced • Output measures of process elements: Customer satisfaction surveys of factors such as quality, flexibility • Output measures comparable across sector: Cost of product, market share, quality performance • Output strategic success measures: Growth in revenue, market share, improved profitability, higher value added.
Specific Measures of Internal Workings	• No. new ideas generated at start of innovation process • Failure rates • No./% overruns on time and cost • Customer satisfaction measures – objective based • Time to market • Human hours of development per product innovation • Continuous improvement measures eg no. problem solving teams, savings accrued per worker
Influential Conditions	• Creative climate of organisation • Extent of clear deployment and communication of strategy

Table 3. Compiled Descriptions of Innovation Performance. After: Tidd J., Bessant J. & Pavitt K. 2005. *Managing Innovation: Integrating Technological, Market and Organisational Change.* (3rd Ed.). Wiley. Chichester. UK. pp561-569.

The varied subjects of the performance measures and concepts of performance show that the performance of an innovative product and the organisation that produce it are inter-related and often inseparable (Chiesa *et al.* 1996, Lawless & Fisher 1990). For example, unit, production and development costs are financial aspects of performance of the innovative product that may influence the financial performance of the organisation. Indeed, organisations in the medical device field may exist to exploit a sole innovative product. Customer satisfaction measures may apply to both the product or organisation as a whole, yet are likely to be perceived in a similar way by customers, given that joint product service packages are often offered.

Most of the research shown in Table 4 operationalised the concepts in empirical work by using Likert scales, reflecting the quantitative research designs used in those studies. However, many of the concepts themselves, as well as the empirical measures used are perceptual, as discovered by Wei & Morgan 2004. The Likert scales as well as the instruments used by Griffin and Page (1996), Atuahene-Gima *et al.* (2005) and Lemmink *et al.* (1998) again highlight the perceptual nature of performance as a concept.

Study	**Outline**	**Concepts of Performance Used**	**Empirical Implementation of Performance Concept**
Griffin & Page (1996)	Assessing success or failure of a product development project using measures of performance concepts. Appropriate measures are contingent on project type.	Success of product development projects is described in terms of: • Customer-based success (such as satisfaction, acceptance) • Financial success (such as met profit goal or IRR/ROI) • Technical performance success (such as met performance specs)	Product development professionals selected most useful measures from a variety proposed.
Hultink *et al.* (1997)	Investigates the product development performance of various new product launch strategies.	Overall, customer determined, financial and technical product performance. In particular product measures included: • Meeting quality goals • Development costs • Launched on time • Speed to market • Product performance	1 to 7 Likert scale ratings by manager respondents regarding particular new product development projects.
Song *et al.* (1997)	Investigating impact of skills, synergy and design sensitivity on new product performance	• ROI • Profit • Market share • Sales • Opportunities for technical leadership • Market dominance • Customer satisfaction	1 to 5 Likert scale ratings by manager respondents regarding particular new product development projects.
Wei & Morgan (2004)	Investigating factors of new product success.	For new product performance: • Management satisfaction with new product performance • Overall new product performance • Market strength attributable to new products	1 to 5 Likert scale ratings by manager respondents regarding perceptions of new product performance.
Sherman *et al.* (2005)	Researches the role of cross-functional integration and knowledge management in new product development performance.	• Product prototype development proficiency • Product launch proficiency • Product development cycle time • Design change frequency • Market forecast accuracy • Technological core competency fit	1 to 5 Likert scale ratings by manager respondents regarding perceptions of new product performance, metrics taken from extant literature. *Continued overleaf*

Atuahene-Gima *et al.* (2005)	Researches the responsive and proactive market orientations for new product programme performance.	New product programme performance: • Extrapolation of key trends for insight into what customers in current market would need in the future • Revenues from new products compared with business unit objectives • Profitability of new products compared with business unit objectives • Growth in profitability of new products compared with business unit objectives • Growth in sales of new products compared with business unit objectives	Survey of managers ranking on pre-existing and new metric scales.
Radnor & Noke (2006)	Develops innovation audit tool for product innovation process in an organisation	• Structure • Leadership • Teams • Outputs • Context	Quantitative survey and qualitative semi-structured interviews
Wilson & Jantrania (1994)	Dimensions of product value	• Economic • Strategic • Behavioural	Conceptual study, literature based.
Lemmink *et al.* (1998)	Dimensions of product value	• Emotional • Practical • Logical	1 to 11 Likert scale ratings by customer respondents regarding restaurant experience.

Table 4. Concepts of Performance of Innovative Products in the Innovation Literature.

So far the literature has recognised increasingly broad aspects of performance, from a variety of perspectives within and beyond the organisation, particularly where performance of innovative products is considered. Much discussion of aspects of performance has drawn upon the literature on performance measures and measurement. The next section discusses this literature in more detail.

2.4. Performance Measurement

A large part of the literature on performance concentrates on the topic of performance measurement. This section of the literature review defines and analyzes the concept, then discusses the key theme in the literature of selecting and implementing performance measures and measurement systems. The section also investigates literature themes on evidence and evidencing and measuring performance in the implementation of innovative products.

2.4.1. Definition and Concept of Performance Measurement

A performance measure is defined by Neely *et al.* (2005) as: *"a metric used to quantify the efficiency and/or effectiveness of an action"*. Although this definition was produced on the basis of a review of the performance measurement literature, it is limited when viewed in the context of the broader performance literature reviewed in this research. Efficiency and effectiveness are broad descriptions of performance, but the literature also includes research on softer aspects of performance such as quality of life (Skevington 1999) and more qualitative aspects of performance in general (Teece 1992), that are not viewed from such a mechanistic, operational viewpoint. The definition presents measures as objective, though the human element involved in using a measure suggests that there is some subjectivity involved (Johnson & Kaplan 1987 pp253-262). The discussion of quantification is not inclusive of softer, qualitative measures and the term 'metric' is a narrower term that is often used to replace 'measure', alluding to quantitative, decimal scales. Expressing the concept of measurement, Farbey *et al.* (1993 pp75-94) described how a measurement procedure maps and preserves the difference in a set of symbols and the difference in attributes of a collection of entities. This expresses the same basic phenomena as Neely *et al.* (*ibid.*), yet reflects the broader concepts in the literature. It is shown in Figure 4.

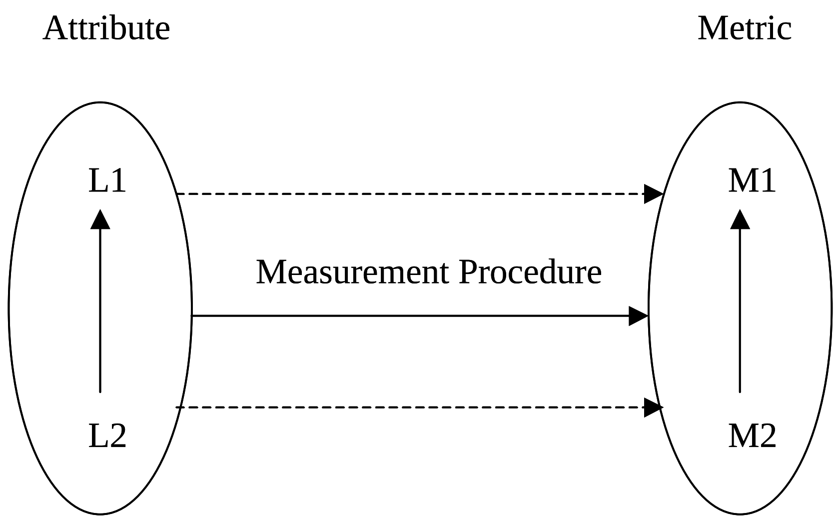

Figure 4. Diagrammatic View of Measurement. After Farbey B., Land F. & Targett D. 1993. *How to Assess Your IT Investment. A Study of Methods and Practice*. Butterworth-Heinemann. Oxford. UK. Fig 6.2.

As suggested by the Neely *et al.* (2005) definition and criticism of it, views of measures and the process of measurement in the literature come from a variety of philosophical viewpoints from natural science to social science. These are summarised in Table 5. The different perspectives of measures cover both objective natural science and subjective social science measures and measurement processes. The latter tend to be more qualitative, taking far more account of the role of humans in the measurement process, than quantitative natural science views. However the qualitative aspects of subjective social science measures are often given numerical values and turned into quantitative measures (Chiesa 2007). Literature on the background to performance measures also discusses issues of validity of measures and whether to use nominal, ordinal, interval or ratio scales for example (Bryman 2004 pp65-75, 225-227). On a broader view, the literature predominantly takes a rational Chandlerian, coordination and allocation view of measures (Chandler 1977 pp484-502), though literature on choosing and implementing measures suggests a more Mintzbergian view that an over-obsession with quantification is harmful (Mintzberg 1996).

Background to View of Measurement	**Example of Discipline Where view is Used**	**Example of Measurement Subject & Instrument**	**Key Tenets of Approach**	**Example in Literature for Current Approach**
Natural (Physical Sciences) View	Physics	Heat with thermometer	Hard, (more objective). Comparison is made between magnitude of quantity of the object being measured, and a standard unit. Conditions controlled. Every measurement has an inherent degree of uncertainty, and may be given with an error margin and confidence level of falling within that margin.	Hard financial and operational parameters (eg number of patents filed, ROI on product innovation). Eg Ridgway (1956), Slack *et al.* (2007 pp39-54)
Social Sciences View	Psychology	Intelligence with IQ test	Soft, (more subjective), less tangible subjects. Magnitude is quantified using probabilistic and psychometric tools such as questionnaires or surveys.	Human factors, technological knowledge necessary for product innovation. Eg Lamming *et al.* (1996)

Table 5. Literature Views of Measurement from Natural and Social Science Backgrounds.

Being a prominent part of the performance literature, discussion of performance measurement reflects themes in the development of the performance literature as a whole. For example financial performance measures are often used in the accounting based literature (Biddle *et al.* 1997, Ferguson & Leistikow 1997), the early literature (Ridgway 1956) and often where a sole performance measure is used (Hendricks & Singhal 2003). However operational measures have received increasing attention, as they lead or drive future financial performance, whereas financial measures follow performance, showing the results of management action already taken (Kaplan & Norton 1992, Ittner & Larcker 1998a). Also there is an emphasis on using measures taking a view external to the organisation, focussing on customer satisfaction. Johnson & Kaplan (1987 pp253-262) also promote a broader description of organisational performance than the traditional financial measures, which they describe as rooted in nineteenth century cost accounting and inappropriate for the increased dynamism and competition in the contemporary business setting.

While recent literature consistently advocates a broad range of financial and non-financial measures, there are differing views on how non-financial measures drive financial performance measures. Anderson *et al.* (1994) found that customer satisfaction in a sample of Swedish firms was related to return on investment, yet the relation was less strong or did not occur in service firms. Similarly, Ittner and Larcker (1998a) found that customer satisfaction measures were related to financial measures such as market values and revenue growth. However their study also shows that the extent to which non-financial measures drive financial performance varies or even does not exist depending upon the industry.

The range of performance measures are not only becoming broader, but more diverse and specialised. For example, Skevington (1999) developed a set of measures of quality of life, with particular reference to health. The psychology based work uses measures to describe 'soft' intangible aspects of quality of life, with facets including the presence or absence of positive feelings as well as mobility and energy measures for categorised diseases. An example of other subjective, qualitative aspects of performance is Parasuraman *et al.*'s (1988) SERVQUAL model of service performance, measured in terms of aspects such as credibility and courtesy. Further specialist types of performance measures include those of innovation, discussed above when defining performance of innovation (Tidd *et al.* 2005 pp561-569, Chiesa *et al.* 1996). However Coombs and Bierly (2006) emphasise that performance measures in the technology field usually have shortcomings. The broad range of performance measures reflect the broad conceptualizations of performance found in the literature.

2.4.2. Selection and Implementation of Performance Measures

Having described a range of types of measures, the literature also discusses their appropriate selection and implementation (Hammer 2007, Purbey *et al.* 2007, Robson 2005, Bititci *et al.* 1997, Kaplan & Norton 1992, Lea & Parker 1989, Fortuin 1988, Johnson & Kaplan 1987 pp253-262, Globerson 1985, Ridgway 1956), including a summary of existing work in the area (Neely 1997). Table 6 summarises the literature concerned.

Publication	Recommendations for Effective Performance Measures	Description of Research Principles
Hammer (2007)	• Decide what to measure • Measure the right way • Use metrics systematically • Create a measurement friendly culture	Guidance to avoid 'the 7 deadly sins of performance measurement', enabling performance improvement
Purbey *et al.* (2007)	• Sensitivity to changes in internal and external environment of organisation • Reviewing and reprioritising internal objectives when environmental changes are significant • Deploying changes to internal objectives and priorities to critical parts of the organisation • Ensuring that gains achieved through improvement programs are maintained	Guidance for characteristics of a performance measurement system for healthcare processes
Robson (2005)	• Measurement system must provide relevant graphical information at local level • Performance measurement information must be in form that assists people in perceiving their control of performance as part of their job • Measurement system designed from the outset with psychological consequences in mind	Examines how to implement a performance measurement system that creates a high performance culture
Bititci *et al.* (1997)	• System deploys corporate and stakeholder objectives throughout organisation • System defines key competitive factors, position of business within competitive environment • Focus on key business processes to manage performance • A measurement methodology differentiating between actuality, capability & potentiality • Use of proactive rather than reactive measures	Presents reference model for a performance measurement system, as a critical system embedded within performance management as a key business process
Kaplan & Norton (1992)	• Use a broad based set of measures • Measures should have an associated goal • The opinions of a range of stakeholders should be taken into account	Develops a practical tool consisting of a range of measures intended to avoid maximising performance in one area at the expense of another. Both financial and operational measures should be used, operational measures are the drivers of future financial performance
Lea & Parker (1989)	• Simple to understand • Ensure visual impact • Improvement focussed rather than on variance	Japanese operations management based work using lean principles. *Continued overleaf*

Fortuin (1988)	• Enable fast feedback • Provide information • Be exact and precise about what is being measured • Be objective not subjective	Development of effective indicators, operations research numerical, objective bias.
Johnson & Kaplan (1987 pp253-262)	• Use broader range of operational performance measures rather than traditional accounting measures	Describes the inadequacy of traditional management accounting system measures, advocating a broader, operations based approach to measures.
Globerson (1985)	• Be aligned with strategy • Provide timely and accurate feedback • Relate to specific, stretching but achievable goals • Based on quantities that can be influenced or controlled • Clearly defined • Be part of a closed management loop • Have an explicit purpose • Be based on an explicitly defined formula and source of data • Use ratios rather than absolute numbers • Use data which are automatically collected as part of a process where possible	Effective performance measures must be developed as a basis for effective planning and control performance management. Emphasis on operational performance criteria.
Ridgway (1956)	• Both qualitative and quantitative performance measures must be used to avoid dysfunctional consequences • Performance measures must be chosen to determine the right behavioural consequences	Describes and gives suggestions for mitigating the effects of dysfunctional consequences of performance measures

Table 6. Advice for Effective Performance Measures in the Literature

A repeated theme across the various publications is the need for a broad range of both financial and non-financial measures, though there is some conflict as to how this should be achieved. Fortuin (1988) proposes objective measures, which is inconsistent with Johnson and Kaplan (1987 pp253-262) proposing use of behavioural measures. There is also a focus on performance measurement systems, rather than individual measures. Another theme is the need for following up performance measurement, Globerson (1985) discusses a closed management loop, Robson (2005) referring to use of performance measurement information in follow up action and Fortuin (1988) describing the importance of feedback. In a similar vein Lea and Parker (1989) discuss performance improvement, alluding to some kind of feedback. Feedback is discussed further in the following sections.

2.4.3. Evidence and Evidencing

Evidence and evidencing is a growing contemporary theme in the literature on performance. Also the term ‘evidence-based’ is now used widely by practitioners. The concept originates in diverse subject areas including law, which recognises different types of evidence which have different degrees of confidence (Twining 2003); as well as in medicine (Sackett *et al.* 1996).

Evidence-based medicine began with observations of broad variations in clinical practice, lack of use of care strategies of known effectiveness and continued use of care strategies acknowledged to be ineffective. The rationale of evidence-based medicine involves combining the best available external research evidence with expertise of the clinicians involved in a particular patient case (Sackett *et al.* 1996), enabling clinicians and patients to make choices about the most effective strategy of care to follow (Glasziou & Haynes 2005). Given that medical devices are a key part of many care pathways and strategies, it follows from the literature that evidence of their effectiveness is required from measurement of their performance. In practice, external evidence comes from sources such as clinical trials (Tonelli 2006), while internal evidence is based on experience and judgement of the individual clinician and the particular situation of the patient. Again, this highlights that performance measurement can involve harder, subjective as well as more perceptual, subjective approaches to evaluation (MacIntyre & Petticrew 2000). Haynes (1991) emphasises the varying quality and relevance of different evidence sources, while Sackett and Wenneberg (1997) state that evidence from the most appropriate research design must be used, given the variety of individual cases where evidence is required. Muir Gray (2004a pp11-18, 65-100, 2004b) closely associates evidence-based healthcare with evidence-based policymaking, a term referring to provision of evidence about effective public policy interventions, guiding public policy generation and implementation (Bambra 2005).

One of the most recent evidence-based terms to evolve is evidence-based management (Pfeffer & Sutton 2006), advocating that organisations should be managed on the basis of what actually works, rather than untested ideas or assumptions. They comment that many managers trust research less than they trust their own experience, also stating that: *"Lots of managers, likewise, get their companies into trouble by importing, without sufficient thought, performance management and measurement practices from past experience."* (Pfeffer & Sutton *ibid.*).

In summary, the evidence-based literature highlights that many different processes can be used to measure performance and that a variety of different types of information can be considered as evidence. The literature also demonstrates the importance of appropriate performance measurement, particularly in the public and healthcare settings and has a focus on new or innovative products. Evidence-based approaches encourage purchasing decision-makers, including clinicians, to take account of a wide variety of purchasing decision-making criteria, from quantitative and qualitative external data from other parties, to their own internal assessments. This may include seeking out organisations that evaluate products, or testing products themselves, perhaps with the aid of the supplier.

2.4.4. Measuring Performance in the Implementation of Innovative Products

Literature discussed so far has recognised the inter-organisational context of performance measurement, that performance can be perceived differently internally and externally to the organisation (Chenhall & Langfield-Smith 2007, Kaplan & Norton 1992) and that performance measurement information is gathered from sources external to the organisation (Sackett *et al.* 1996, Pfeffer & Sutton 2006).

Topics such as vendor or supplier assessment discuss performance measurement in an inter-organisational context. Vendor assessment (Timmerman 1986) is often a part of the broader purchasing process, where information is gathered to inform a purchasing decision, with information not only gathered on the product, but also on the product supplier. Weber *et al.* (1991) refer not to vendor assessment, but to vendor selection, showing how suppliers may be selected following assessment. The criteria for assessing suppliers vary from performance measures of their product as above, to specific measures of the supplier, such as satisfaction, flexibility, risk and confidence, as proposed by Humphreys *et al.* (2005) who focussed on measuring suppliers involved in product development. Ellram (1995) discusses how supplier evaluation can be used to select suppliers, form a basis for negotiation, monitor supplier performance and improve supplier performance. As the vendor or supplier assessment literature has moved towards selection of suppliers, the role of performance measurement in making purchasing decisions about which supplier and product to choose is increasingly apparent.

In the last chapter analysis of the implementation part of the innovation process highlighted key inter-organisational processes of social and information exchange, in particular purchasing and supply decision making. From the perspective of the performance literature, the information and social exchange used to gather information for use in the innovation process (Tidd 2005 pp88-97, Basadur & Gelade 2006, Schoen *et al.* 2006, Miaoulis & LaPlaca 1982) and on which to make a purchasing decision (Webster & Wind 1972 pp12-39, 77-107, Biemans 1992 p48, Zaltman *et al.* 1973 pp66-67) is a performance measurement process. The purchasing and supply and innovation literature discussed in the last chapter shed light on this subject.

Individuals may use a variety of criteria in their evaluation of a number of possible purchases, such as a potentially large amount of factual information involved in technical evaluation of new equipment that may be purchased. (Webster & Wind 1972 pp6-7) describe how: *"Technical evaluation of new equipment requires a great deal of factual information as well as carefully studied opinions…"*. In addition to performance measurement of technical criteria, they comment that much information is required to make purchasing decisions, particularly as: *"Purchased products and services are expected to contribute dependably to the organisation's performance over long periods of time…"* (Webster & Wind *ibid.*), highlighting how product performance is often associated with organisational performance.

Webster and Wind (1972 pp88-107) discuss how individuals learn to use particular information sources, interacting with others in their own organisation, supplier organisations or the environment to gain information to be used as part of a purchasing decision. Regarding psychological processes of the buyer, cognition and learning are two elements of particular interest to performance measurement between organisations. The former refers to receiving and interpreting information from the environment, while the latter refers to previous behaviour influencing current behaviour, for example an individual favouring a product because of their previous experience with it.

Having analyzed the existing literature on performance measurement, another similar term uncovered in the literature review is criticised in the next section, on performance management.

2.5. Performance Management

Further to existing research on performance measurement, the term 'performance management' is also found widely. Use of the term is conceptually loose and often not distinguished from performance measurement (Radnor & McGuire 2004). This section sheds light on the concept of performance management in existing literature by referring to basic concepts of management, before discussing how existing literature describes performance management with respect to performance measurement, then considering some performance management processes from the literature.

2.5.1. Concepts of Management

'Management' is a very broad and evolving concept and body of knowledge. Mintzberg (1990) gives ten perspectives on management, described as schools of thought for strategy formation given the overarching nature of strategy across various areas of management research. He later re-iterates these ten schools, shown in Table 7, describing how recent research is cutting across their boundaries (Mintzberg & Lampel 1999). The 'planning' perspective is taken in this research, as it underpins the operations management, purchasing and supply management field in which this research is based. Often described as planning and control (Slack *et al.* 2007 p24-25) and with a focus on operational processes (Slack *et al.* 2007 pp8-16, Godwin *et al.* 1989), the perspective suggests that performance management involves planning and control action of processes such as purchasing and innovation.

2.5.2. Concepts of Performance Management with Respect to Performance Measurement

Reviewing the literature shows that there is a lack of conceptual clarity regarding the terms 'performance measurement' and 'performance management'. Indeed some literature does not distinguish between the terms or uses the two interchangeably (Radnor & McGuire 2004). Radnor and Lovell (2003) refer to performance management systems (PMS), using the term for combined systems that involve both performance measurement and performance management. This suggests an overlap in the literature between the two conceptually unclear terms. However some existing publications can be used to provide a clue as to how the respective terms are defined and might be distinguished.

The concepts of management analyzed above suggest that performance management involves actions of planning and controlling performance, indeed wide use of the term in the literature reflects this. For example Bourne *et al.* (2003) describe how organisations are increasingly focussing upon managing performance improvement and drivers of performance, as well as measuring performance. Further, Kaplan and Norton (1996) talk about use of the BSC as a strategic management system in follow up work to their original BSC paper where it was described from a performance measurement point of view. This concept of performance management as some sort of planning and controlling action in addition to performance measurement is found widely.

Perspective	Base Discipline	Intended Message	Realised Message
Design	None, architecture can be used as metaphor	Fit	Think (strategy making as case study)
Planning	Systems theory, operations management, urban planning	Formalise	Program (rather than formulate)
Positioning	Economics (industrial organisation), military history	Analyze	Calculate (rather than create or commit)
Entrepreneurial	Some early economic work	Envision	Centralise (then hope)
Cognitive	Psychology	Cope or create	Worry (being unable to cope in either case)
Learning	Some links to chaos theory in mathematics, learning in psychology, education	Learn	Play (rather than pursue)
Power	Political Science	Promote	Hoard (rather than share)
Cultural	Anthropology	Coalesce	Perpetuate (rather than change)
Environmental	Biology	React	Capitulate (rather than confront)
Configuration	History	Integrate, transform	Lump (rather than split, adapt)

Table 7. Ten Perspectives on Management. After: Mintzberg H. & Lampel J. 1999. Reflecting on the Strategy Process. *Sloan Management Review.* 40(3) pp21-30. Table 1.

Halachmi (2005) describes performance management as: "*…a broader and more meaningful concept than simple performance measurement*", listing processes indicative of broader performance management such as catering to stakeholders, attending to human behavioural factors and handling issues in the environment. Bititci *et al.* (1997) define performance management as a process that allows an organisation to handle its performance in line with strategy and objectives. Bourne *et al.* (2005) describe that whereas past research has focussed on choice and implementation of performance measures, future research will have to look at how performance measures are used in performance management processes. Agreeing, O'Neill (2006) describes a performance management system as using performance measures to determine whether performance improvements are made. By focusing on the use of evidence, or information from performance measurement in healthcare, policymaking and management, the evidence-based literature includes a broader range of planning and control actions or processes than just measuring performance. It recognises the purpose of evidence for use in processes such as healthcare and management and highlights the role of feedback, where action is taken on evidence.

A key performance management process, also highlighted in the innovation chapter, is feedback. When analyzing performance measurement, Globerson (1985) emphasise the importance of a feedback loop, a broader planning and control or management process by which actual performance is constantly compared with performance measurement outputs. Similarly, Globerson (1985) discusses how feedback can lead to taking action and initiating changes to the organisation. Further, Argyris (1990) describes use of performance measurement systems as a form of control. Nanni *et al.* (1990) agree, suggesting that feedback enables managers to control performance to a defined level. Further to Globerson, Radnor and Barnes (2007) suggest that feedback control must be added to a measurement system to make it a management system. They refer to comparison of outputs with target values and taking corrective action, stating that a performance management system must communicate information, motivate appropriate behaviour and provide a mechanism for control, intervention and learning. Reinforcing Globerson's (1985) suggestion of feedback and the proactive processes suggested by Halachmi (2005), Bititci *et al.* (*ibid.*) describes the objectives of performance management as providing: *"…a proactive closed loop control system where the corporate and functional strategies are deployed to all business processes, activities, tasks and personnel, and feedback is obtained through the performance measurement system to enable appropriate management decisions."* They describe performance measurement as an information system that lies at the heart of performance management, suggesting that management planning and control action uses an information output from performance measurement. Also discussing the function of information, Chiesa and Frattini (2007) describe the measurement process as including gathering of data, analysis of results and identifying corrective actions, echoing the idea above of active control. Overall, publications in this area suggest that performance measurement must have an explicit purpose, with Globerson's (*ibid.*) work for example raising the question of how performance measurement and performance management processes may influence performance, an issue investigated later.

Further to the literature that can be used to define performance management, limited existing work has differentiated performance measurement and performance management. Lebas (1995) states that the first involves various types of performance measures, while the latter involves processes and characteristics such as training, teamwork and incentives. Lebas gives details of performance measurement and performance management in a table, reproduced here as Table 8.

Performance Measures	Performance Management
Measures based on key success factors Measures for detection of deviations Measures to track past achievements Measures to describe the status potential Measures of output Measures of input	Training Team work Dialogue Management style Attitudes Shared vision SPC Employee involvement Multicompetence TQC Incentives, rewards

Table 8. Processes and Preoccupations of Performance Measurement and Performance Management. After: Lebas M.J. 1995. Performance Measurement and Performance Management. *International Journal of Production Economics.* 41(1-3) pp23-35.

Lebas (1995) makes a rare attempt to distinguish performance measurement and performance management from one another, though the descriptions given in Table 8 do not focus on both concepts as processes, as descriptions of performance measurement focus on measures used instead. Lebas (*ibid.*) suggests that performance management precedes performance measurement, that the two are complementary, yet cannot be separated. This is explained in an image shown in Figure 5.

Lebas (1995)' conceptualization reflects some aspects of the literature by graphically showing performance management as broader than performance measurement (Bititci *et al.* 1997), yet also raises some questions. Lebas (1995)' conceptualization suggests with the time arrow that the latter precedes the former, which does not fit with the concept of follow up performance management processes, such as feedback (Globerson 1985).

Further to suggesting that performance management processes are broader than or follow up on performance measurement processes (Halachmi 2005, Lebas 1995, Bititci *et al.* 1997), some existing literature suggests that a difference can be drawn between the concepts on the basis of whether they influence performance. Research has highlighted that performance measurement alone cannot change performance, whereas planning and control action on the basis of performance measurement can (Halachmi 2005, Hume & Wright 2006). The influences of performance measurement and performance management processes on performance are discussed further later.

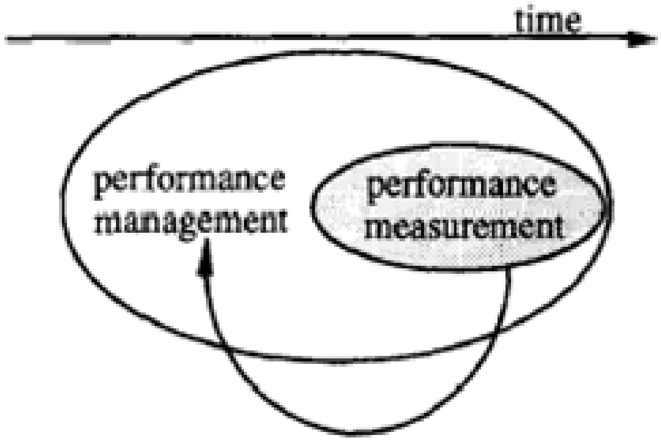

Figure 5. Relationship Between Performance Measurement and Performance Management. After: Lebas M.J. 1995. Performance Measurement and Performance Management. ***International Journal of Production Economics.*** **41(1-3) pp23-35. Fig 9.**

2.5.3. Performance Management Processes

The performance literature has included a number of planning and control processes that are broader than or follow performance measurement, so can be considered performance management processes. More are found in the innovation and purchasing and supply literature from the last chapter. A selection are summarised in Table 9.

The literature emphasises that the various types of exchange between interacting organisations and individuals underpin performance management processes. Information and social exchanges (IMP Group 1982) occur with exchange of information from performance measurement, which is then used for planning and control activities as investigated above. These include issuing strategic objectives, practice guidelines and tools (Bititci *et al.* 2005, 2000, Simons 1991, Hume & Wright 2006) and training (Lebas 1995).

Referring back to the literature in the last chapter, many processes in purchasing and supply and the implementation part of the innovation process are performance management processes. For example feedback of information from performance measurement is emphasised in the performance literature (Globerson 1985) and in the innovation process involves a key exchange of information (Tidd *et al.* 2005, pp88-97, Zaltman *et al.* 1973 pp71-77) that can be used in re-innovation of the innovative product (Rothwell & Gardiner 1988), a planning and control action. Also, purchasing and supply decision making to adopt an innovative product (Webster & Wind (1972 pp28-37,89-106, Pfeffer & Sutton 2006, Biemans 1992 pp129-140, Ellram 1995) involves planning and control processes of evaluating alternatives and making a decision on the basis of information gathered.

Process in Literature	Literature	Description of Process
Information, social exchange	IMP Group (1982), Fortuin (1988)	Actors exchange information in relationships and networks, performance measures should be used to provide information for other actors
Feedback following performance measurement	Globerson (1985)	Managers use the outputs of performance measurement to plan and control
Deployment of strategic objectives, practice guidelines and tools	Bititci *et al.* (2005), Bititci *et al.* (2000), Hume & Wright (2006), Simons (1991)	Management team deploys guidance and tools to be used to improve performance, ascertained in performance measurement
Catering to stakeholders, attending to human behavioural factors, handling issues in environment	Halachmi (2005)	Draws on definitions of management as controlling behavioural aspects of individuals, organisation and management
Training, teamwork, incentives	Lebas (1995)	Individuals are trained, teamworking is encouraged and incentives offered, as processes of performance management
Using performance measurement systems as strategic management systems	Kaplan & Norton (1996)	Performance measurement systems are not only used to measure performance, they may be used as systems to strategically manage performance
Evidence-based management	Pfeffer & Sutton (2006)	Combining best available internal and external evidence to make a decision and take action on evidence
Making a purchasing decision	Webster & Wind (1972 pp28-37,89-106)	Performance measurement is often carried out with the aim of making a purchasing decision, similar to evidence-based management
Making a decision to adopt an innovation	Biemans (1992 pp129-140), Zaltman *et al.* (1973 pp66-67	Adoption of an innovation includes steps of determining specification, comparing options and selecting from sources
Supplier selection and improvement	Ellram (1995)	Selecting a supplier, aiding them to improve their performance, following assessment.
Re-innovation	Rothwell & Gardiner (1988)	Innovation of the product after its invention and introduction.

Table 9. Performance Management Processes from the Literature

This section discussed concepts of performance measurement and performance management and how they might be differentiated, finding that the latter are broader than, or follow up planning and control processes to, performance measurement. The literature also suggests that performance management processes are those that influence performance, unlike performance measurement. This raises questions about the role and purposes of performance measurement and performance management, which are discussed in the next section.

2.6. Role and Purpose of Performance Measurement and Performance Management

Radnor and Barnes (2007) have suggested that future performance measurement and management research should investigate how the processes enhance and drive performance improvement, indeed the literature suggests that this is one way that the two concepts could be differentiated. While a few publications have discussed the topic, there is limited literature in the area and other publications have referred to roles in passing.

Neely (2004) states that a big challenge exists for research in determining whether performance measurement systems are worth it. In the healthcare context, Tarr (1996) analyses whether and how performance measurement systems are worth it. A few limited studies have been carried out in this area, with conflicting results. Davis and Albright (2004) investigated whether the financial performance of bank branches using the BSC was better than those branches that do not use the BSC. Using quantitative, quasi-experimental methods, the study found better financial performance for those branches that had implemented the BSC. Also, Banker *et al.* (2000) found that using non-financial performance measures are associated with financial performance in the future. In contrast Neely *et al.* (2004) conducted a similar study on the performance of branches of a construction firm, finding in preliminary results that there was little difference in performance between branches that did and did not use the BSC. Similarly, Perera *et al.* 1997 found that an emphasis on operations based measures in an organisation was not associated with enhanced organisational performance. As well as giving conflicting results, these studies have limited generalisability as they use quantitative research designs, mainly focussing on financial performance of the organisation.

Other studies have touched on related areas, such as Ittner *et al.* (2003a), finding that organisations using a broader set of financial and non-financial performance measures had greater measurement system satisfaction and stock market performance. However the research used a narrow description of performance, which is not consistent with the contemporary thrust in the literature for broader descriptions, limiting generalisability of the study. Evans (2004) produced results suggesting that organisations with more mature performance measurement systems have better reported results in terms of financial, market and customer performance, the research again conducted using quantitative methods. In contrast De Waal and Coevert (2007) studied the effects of a new performance management system using qualitative methods finding different effects according to the way the system was used, however the research was limited to one fairly small organisation.

Some work in the performance field has described how performance measurement is used in performance management, to improve performance. Robson (2005) advocates designing measurement systems from the perspective of managing performance, suggesting that this is a means for obtaining performance improvement. Concurring, Neely (2004) describes a number of fundamental processes of setting up a performance measurement system, in particular a process of *"managing through measures"*. However these publications highlight that while performance measurement processes are important, broader planning and control processes are being used to manage performance on the basis of performance measurement to gain performance improvement. Globerson (1985) and Bourne *et al.* (2005) suggest that it is not just performance measurement but performance management that is required for measures to change performance. Melnyk *et al.* (2005) describe the importance of aligning performance measurement processes with strategic objectives for appropriate performance consequences, also implying that performance measurement alone may not have a role in performance, only when supplemented by performance management. Olsen *et al.* (2007) concur, stating that performance measurement systems provide the information needed for monitoring, controlling, evaluation and feedback functions in operations management.

In applied public sector case research, Hume & Wright (2006) showed that performance measurement alone is unlikely to improve performance. This is described expressively in the article title: *"You Don't Make a Pig Fatter by Weighing It"*. Similarly, Radnor and McGuire (2004) state how performance management intends to respond to outputs from measures to manage performance, implying how performance management is used to alter performance. In a similar vein, Robson (2005) emphasised the importance of individuals recognising that they are in control of performance through taking action on performance measurement information, if a culture of high performance is to be encouraged. Haque and James-Moore (2005) focused on the role of performance measurement in new product development, finding in accordance with other work discussed that performance measurement is not just used for reactive monitoring, but proactively to disseminate strategy and change culture.

Neely and Al Najjar (2006) also emphasise a learning role, in which managers are challenged by measurement outputs about how best to carry out their role. Chiesa and Frattini (2007) describe the purposes of a performance measurement system, with a focus on research and development activities. Purposes include supporting decision making, enhancing R&D performance, motivating personnel, supporting incentive schemes, fostering organisational learning, enhancing communication and coordination and reducing R&D risks. These results highlight that while performance measurement can enhance performance, it does so through backing up processes such as decision-making, learning and communication.

The evidence-based literature suggests that for a beneficial outcome, measurement alone is not required, but appropriate measurement that is used to make the right decisions in a management process. Pfeffer and Sutton (2006) state that: *"…evidence-based management can change how every manager thinks and acts…it proceeds from the premise that using better, deeper logic and employing facts, to the extent possible, permits leaders to do their jobs more effectively."*. This advocates using both performance measurement and performance management to achieve the beneficial results of evidence-based management. Similarly, Nilsson and Kald (2002) found that performance management systems can be used diagnostically and interactively, particularly pointing out their use in decision support at strategic and operating levels.

Other literature suggests less direct ways that performance measurement alone might influence performance. Beyond discussing whether a performance measurement system has worth for an organisation by having an impact upon performance, Neely (2004) describes a number of other ways in which such a system may have value for an organisation. These include focusing minds upon what is important, communicating and influencing the behaviour of individuals regarding organisational targets and a framework to reach them, checking progress against targets and challenging organisational strategy.

Bull (2007) makes a link between performance measures and their role in a model of performance for an organisation by recognising their contribution to the three dimensions of efficiency, effectiveness and efficacy. They suggest that suitably modelled performance measures prompt asking questions that help an organisation to perform in the dimensions described above. This is based on Bull's (1999) work discussing strategic management from a management accounting perspective, where performance measurement and links to performance are described. Table 10 shows Bull's three dimensions of performance and performance measures, as well as examples of some of the strategic questions that help link performance measures to performance. Again, both quantitative and qualitative measures are used. As with some of the literature discussed above, the questions allude to follow up management actions regarding how the organisation uses resources, responds to demand and adds value or contributes to the true purpose of the enterprise. Although focussed on the organisation, the principles could be transferred to measuring and managing the performance of a product which an organisation implements instead.

Dimension				
Process		**Efficiency** – *the economic use of scarce resources*	**Effectiveness** – *the production of a result or effect*	**Efficacy** – *the production of the intended results*
	Growth management	How can we make best use of the distribution and reinvestment of profits?	How can we maximise growth and value of the firm from the profit available?	How can we optimise the realisation of our vision from the profit available?
	Value-add management	How can we deliver our product or service at the lowest cost?	How can we maximise the value that people receive?	How can we optimise the benefit that our vision provides?
	Funding management	What is the cheapest method of raising the funds we need?	What are the most secure and lowest risk sources of funds?	What sources of funding will best help us to sustain our firm's vision?

Table 10. Bull's (2007) Three Dimensions of Performance and Performance Measurement and Strategic Questions. After: Bull R. 2007. Performance Measurement. *Financial Management.* 1 Nov 2007. pp43-44 Tables 2&3.

The literature has also highlighted issues regarding the role of performance measurement and management in public sector organisations, for example (Gupta *et al.* 1994) suggested that performance measurement systems may be introduced in public organisations to give an impression of being modern and efficient, rather than being implemented to improve performance. These points are reminiscent of the literature on dysfunctional performance consequences of measures (Ridgway 1956), where individuals change their behaviour in response to the measures imposed, often with unexpected consequences. In stating that *"…what you measure is what you get"* (Kaplan & Norton 1992) suggest that performance measurement is intrinsically reflective. They imply measures may have a role in performance, with the indication that this may be dysfunctional. However for these dysfunctional consequences to occur, the literature implies performance management processes are involved through the planning and control actions of the individuals involved.

Summarising some of the literature in this section, Table 11 highlights some of the more specific roles and purposes of performance measurement described. As an overview of all the literature concepts discussed in the area, Table 12 shows some of the suggested roles and purposes of performance measurement and performance management with respect to performance, described here as influences. Although the literature has suggested that performance measurement has behavioural consequences, there is limited and contradictory evidence about the influence of performance measurement. It is doubtful that performance measurement alone has a role in influencing performance. However the literature suggests that performance management processes can have a role in influencing performance by taking planning and controlling actions on the basis of information from performance measurement. These themes are returned to in the conceptualization chapter. Meanwhile the next section summarises the review of the literature.

Summary of Specific Roles and Purposes of Performance Measurement	**Literature**
Disseminate strategy and change culture	Haque & James-Moore (2005)
Learning	Neely & Al Najjar (2006), Chiesa & Frattini (2007)
Supporting decision-making	Pfeffer & Sutton (2006), Chiesa & Frattini (2007)
Enhancing R&D performance	Chiesa & Frattini (2007)
Motivating personnel	Chiesa & Frattini (2007)
Supporting incentive schemes	Chiesa & Frattini (2007)
Reducing R&D risks	Chiesa & Frattini (2007)
Focussing minds upon what is important	Neely (2004)
Influencing individual behaviour re organisational targets and a framework to reach them	Neely (2004)
Checking progress against targets	Neely (2004)
Challenging organisational strategy	Neely (2004), Neely & Al Najjar (2006)
Aid asking questions to help organisation perform	Bull (2007)

Table 11. Summary of Some Specific Roles and Purposes of Performance Measurement Described in the Literature

Influence Implied	**Literature Basis for Influence or Possible Influence**	**Example of Literature Source**
Performance Measurement Role in Influencing Performance	Performance measures have behavioural consequences and are intrinsically reflective. However the influence of performance measurement on performance is still unclear from limited and contradictory literature. Measurement alone is unlikely to alter performance.	Kaplan & Norton (1992), Ridgway (1956), Bourne *et al.* (2005), Melnyk *et al.* (2005), Robson (2005), Davis & Albright (2004), Neely *et al.* (2004)
Performance Management Role in Influencing Performance	The influence of performance management including performance measurement on performance is receiving increasing literature interest. Management planning and control action can alter performance, identified by performance measurement.	Halachmi (2005), Pfeffer & Sutton (2006), Hume & Wright (2006), Bourne *et al.* (2005), Globerson (1985), Robson (2005)

Table 12. Literature Suggestions of the Influences of Performance Measurement and Performance Management

2.7. Innovation and Innovative Products

This section outlines literature that helps illustrate the context of the research, the implementation of innovative products. First, the concepts and process of innovation is described, followed by description of the implementation part of the process.

2.7.1. Concept and Process of Innovation

Concepts of Innovation

The core of innovation definitions in the literature is about the concept of something being new, Freeman (1992 pp59), suggesting that innovation is: *"…the commercial realisation or introduction of a new product, process or system…to be contrasted with invention which is simply the bright idea for a new product, process or system"*. Similarly, Tidd *et al.* (2005 pp5-13) use the term 'change' when defining innovation, though they too use the word 'new'. They place an emphasis upon the imperative of innovating to gain or maintain competitive advantage. 'Novelty' is also used in the literature to describe innovation (Von Hippel 1986, Tidd *et al. ibid.*). Exploitation is also a key part of a definition of innovation (Tidd *et al. ibid.*). Saren (1984 pp11-12) highlights that an innovation only occurs when an invention has been commercialised, or exploited, as a product, process or service. Similarly, Roberts (1988), Freeman (*ibid.*) and Schumpeter (1962 pp57-94) differentiates invention and innovation by the latter involving commercialisation.

Similar terms to innovation include new product development, differentiated by Trygg (1991 p4) and Wynstra (1998 pp15-19) who suggest that whereas product innovation covers an entire process between market need and sales, new product development only covers product planning, engineering design and process planning. This suggests that product innovation is explicitly inter-organisational as it involves supply of the product to the customer. New product introduction (Hines *et al.* 2000 pp401-418), stretches the product development process to the point of first introduction into the market or introduction into additional markets, though still does not focus on the longer term as innovation does. An example in contrast to this focus on the early part of the innovation process is the term re-innovation (Rothwell & Gardiner 1988), used to refer to innovation occurring after invention and introduction of the innovation.

Another key concept in the innovation literature is technology, defined by Skinner (1982 pp464) as: *"…the set of physical processes, methods, techniques, tools and equipment by which products are made or services rendered"*. Utterback and Abernathy (1975) describe how technology changes with time, suggesting how it has a lifecycle of increasing maturity. Further, Ansoff and McDonnell (1990 pp167-170) link cycles in technology with product life cycles when studying innovation. Similarly, Dosi (1982) describes technological trajectories and highlights the role of the environment for technological changes, influencing product design.

Types of Innovation

The literature contains a wide variety of different types of innovation, reflecting different perspectives on focus of the innovation, degree of newness and timeframe (Moore 2004, Bowander & Miyake 1994). Indeed the concept of innovation varies in focus on product or process, as well as in degree of newness (Zaltman *et al.* 1973 pp7-16). A key distinction is made between product innovation and process innovation (Pisano 1997 pp9-10, Tidd *et al.* 2005 pp5-13, Moore 2004, Bowander & Miyake 1994), where the change or element of newness is made to either the product (Gobeli & Brown 1987), or the process used to make and distribute it (Pisano *ibid.*) respectively. However Clarke *et al.* (1995), Bessant *et al.* (1994) and Pisano (*ibid.*) describe how the boundaries between product and process innovation are blurred, as changes can rarely be made to the product without making accompanying changes to the process used to produce it. Some innovations may be classified as either a product or process innovation, for example Bessant *et al.* (*ibid.*) give the example of a new jet powered ferry service. In addition, caution is needed when interpreting the innovation literature so that process innovation and the innovation process do not become confused. The former refers to an element of newness in the process used to make a product (Pisano 1997 pp9-10), while the latter refers to process based frameworks and models of the innovation concept (Rothwell 1992).

A further type of innovation described in the literature is technological innovation, referring to both product and process innovation together (Utterback & Abernathy 1975). This type is pragmatic by involving inter-connected product and process types of innovation in one term, yet also refers to the key role of technology in change and newness in the product or service, as investigated above. Other types of innovation are defined according to degree of newness. Gobeli and Brown (1987) describe incremental innovations and radical innovations. The former involve little technical change and have low benefits for the customer, whereas the latter involve large technical changes and have high benefits for the customer. Incremental innovation is the most widespread type of innovation found in practice, especially those adopted from other organisations and developed, rather than radical innovations that were developed in-house (Freeman 1994).

In summary of the above, the literature refers to various types of innovation depending upon the focus of what is new, the degree of newness, the application or exploitation of the new product or service and the technology involved. Innovation as a whole can be divided up into types, but there are likely to be overlaps and blurred boundaries between them. A horizontal theme is that innovation is shown to be an inter-organisational process, as organisations increasingly need a dynamic approach to adopting and re-configuring technological resources beyond their organisational boundaries (Teece & Pisano 1994).

In analyzing various concepts of innovation as above, previous research has referred to and conceptualised types of innovations as processes, for example product innovation is referred to as the process of producing a product, with an element of newness that is exploited in some way (Tidd *et al.* 2005 pp5-13). However the literature also contains many references to types of innovation that refer to the outputs of the innovation process. For example incremental innovation is a process often associated with continuous improvement (Bessant & Francis 1999), yet *an* incremental innovation may be the outcome of that process, such as an automatic needle positioning machine adaptation in shoe manufacture (Dewar & Dutton 1986).

Literature also draws a difference between the terms product innovation and innovative product. Product innovation mainly refers to the innovation process producing a product, whereas 'Innovative product' focuses on the product. For example Pavitt (1990) and Deszca *et al.* (1999) describe how organisations must keep producing innovative products to compete in the marketplace, highlighting the role of technologies in the products. Thomke and Von Hippel (2002) refer to a number of innovative products in their study of product innovation involving customers. The term is used in the literature to describe a product that is an output of an innovation process and has innovative characteristics, which from the earlier discussion would be newness of some description and that the product is exploited.

The literature refers to both innovative products and services (Pavitt 1990), though as analyzed above, the boundary between the two is blurred. Servitisation (Slack *et al.* 2004) is used to describe how products are increasingly viewed as part of a product service package or offering, or as a product that provides a service. When Pisano (1997) is considered, many of the innovative products studied in the literature include a service element, or are in effect innovative services with a facilitating product, despite being referred to as products. Biemans (1992 pp129-140) studied medical equipment innovations, defined as: *"…a medical instrument that represents a significant (non-trivial) departure from previous patterns of diagnosis, treatment or prevention"*. In this example the innovation is a physical instrument, though it is recognised as having a role in the process of healthcare.

The Innovation Process

The innovation process is investigated now as part of analyzing the concept of innovative products and the inter-organisational process used to produce them. When looking at the existing research as a whole, two views of the innovation process are found (Voss 1984). The technology push view describes research driving application in product innovation before introduction to market, the technology pull view sees customer needs in the market trigger organisations to innovate, producing a product to meet the need. Process models (Godwin 1989 Slack *et al.* 2007 pp8-16) are widely used in the literature to conceptualise innovation, involving a series of stages of the innovation process, leading to production of the innovation as an output (Saren 1984). Some examples are summarised in Table 13.

The models all show broadly similar stages of searching or exploring for an idea, selecting and developing it, then commercializing it in the marketplace. Over-arching observations are that many of the processes require the input of more than one organisation and that the unit of analysis in much of the existing research is the product. Further, many of the models recognise the iterative nature of innovation (Tidd 2005 pp88-97, Basadur & Gelade 2006, Schoen *et al.* 2005, Booz *et al.* 1960 pp10-11, OECD 1992 pp25) and recognise the role of information in the process (Tidd 2005 pp88-97, Basadur & Gelade 2006, Schoen *et al.* 2006, Miaoulis & LaPlaca 1982). Indeed the OECD (1992 pp25) model suggests information exchange and feedback can occur between many different organisations and stages of the process. The Tidd *et al.* (2005 pp88-97) model best illuminates the innovation process overall, as it covers the entire process from initial ideas through to sustaining the innovation in the market, making it congruent with the definition of innovation as opposed to narrower product development definitions. It recognises the iterative nature of the process involving feedback, which is reminiscent of the concept of re-innovation (Rothwell & Gardiner 1988). It also highlights the role of information from inside and outside the organisation, reflecting the inter-organisational nature of innovation. The model is shown in Figure 6 and description of the activity stages are given in Table 14.

Innovation Process Model	**Process Stages**	**Description**
Tidd *et al.* (2005 pp88-97)	• Search • Selection • Implementation (Including: Acquiring knowledge resources, Executing the project, Launching & sustaining the innovation, Learning & re-innovation)	Broad model of stages of the innovation process, including sub-stages of implementation stage. Process is iterative.
Basadur & Gelade (2006)	• Generating • Conceptualizing • Optimizing • Implementing	Stages of the innovative thinking process, highlighting the role of knowledge in innovation. Process is iterative.
Schoen *et al.* (2005)	• Basic research • Invention • Innovation	Cyclical model showing broad stages innovation progresses through, but breaking away from linear model.
Wheelwright & Clark (1992 pp6-9)	• Concept Development • Product Planning • Product/process Engineering • Pilot Production/ramp-up	Stages are interdependent. Requires interaction between various stages of product development. Model is of product development so more limited than innovation.
Booz *et al.* (1960 pp10-11)	• Exploration • Screening • Business Analysis • Development • Testing • Commercialisation	Successive stages may only be reached following success with previous stage, iteration in previous stages may occur. Simultaneous focus on product & process development. Assumes development funnel of screening ideas.
Miaoulis & LaPlaca (1982)	• Assessment • Development • Execution	Model of development for high technology products. Model systematically integrates technological, product and market dimensions. Information has a role at each stage.
OECD (1992 p25)	• Potential Market Identification • Invention &/or Production of Analytic Design • Detailed Design & Test • Redesign & Produce • Distribute & Market	Interactive model of the innovation process. Includes iterations and role of research and an existing corpus of scientific and technological knowledge.

Table 13. Process Models of Product Innovation from the Literature

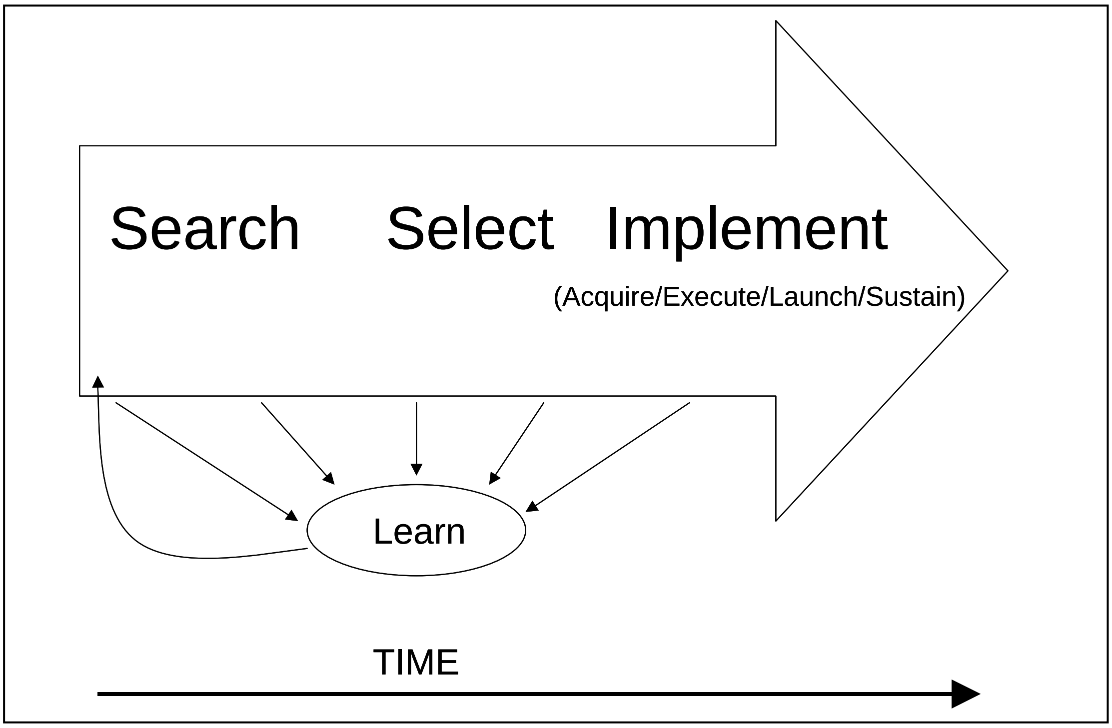

Figure 6. Innovation Process Model. After: Tidd J., Bessant J. & Pavitt K. 2005. Managing Innovation: Integrating Technological, Market and Organisational Change (3rd Ed.) Wiley. Chichester. UK. pp88-97. Fig 2.3.

Activity Stage	**Description**	
Search	Detection of environmental signals of change potential. Identification, processing and information selection.	
Selection	Selection from various technological and market opportunities. Ensuring those selected fit with organisational strategy.	
Implementation	Turning the potential ideas into a product/service reality. Uncertainty gradually reduced as cyclical problem solving improvements to product/service. Includes the below:	
	Acquiring Knowledge Resources	Combination of existing and new intra- and inter-organisational knowledge. Finding, selecting and transfer of technology abilities.
	Executing the Project	Project management activities in uncertain conditions, combining different knowledge sets. Iterative problem solving activities. Involvement of suppliers/users. Concurrent development.
	Launching & Sustaining the Innovation	Activities of preparing the market into which the innovation will be launched. Information collection and problem solving. Dialogue between marketing and product development. Change management.
	Learning & Re-innovation	Creation of new stimuli for restarting innovation cycle. Project review and audit. Feedback into new generation.

Table 14. Activities of the Innovation Process. After: Tidd J., Bessant J. & Pavitt K. 2005. Managing Innovation: Integrating Technological, Market and Organisational Change (3rd Ed.) Wiley. Chichester. UK. pp88-97.

Rothwell (1992) classifies innovation process models into five generations, summarised in Table 15. The classification shows how models have developed, increasingly recognizing innovation as an inter-organisational process and that interaction and feedback between a variety of organisations is involved. Recent literature agrees, describing innovation as an open (Gassmann 2006) and less linear process (Collins 2006, Schoen *et al.* 2005). Collins (*ibid.*) describes how organisations are increasingly accepting ideas and information from external sources as part of the innovation process, taking a collaborative approach to dealing with other organisations. Indeed, innovation is not just depicted as a process that cannot be carried out within one organisation, but one that requires interaction between organisations for success (Ritter & Gemunden 2004, Chapman & Corso 2005, Grandori & Soda 1995).

Generation of Innovation Process Model	**Description**
1st / 2nd	Linear process models, technology push and pull
3rd	Interactive models, involves interaction and feedback between stages of innovation
4th	Parallel model, involving integration within and outside the organisation. Linkages and partnerships are involved.
5th	Integration of systems, networking, flexibility and customisation

Table 15. Five Generations of Innovation Process Models. After: Rothwell R. 1992. Successful Industrial Innovation: Critical Success Factors for the 1990s. *R&D Management.* 22(3) pp221-239.

Having discussed key stages in the innovation process and the increasing role of information and interaction between a variety of organisations, the next sub-section focuses on the implementation part of the process.

2.7.2. Implementation of Innovative Products

Existing studies have often limited their research to a particular part of the broad innovation process, such as studies that concentrate on invention, product development or the inter-organisational part of the process between supplier and end customer. This research focuses upon this later implementation part of the innovation process and literature defining and discussing this part of the process is described here.

Zaltman *et al.* (1973 pp66-67) refers to a decision making process with two broad stages and five sub-stages. The broad stages are initiation and implementation. Initiation includes knowledge awareness, formation of attitudes towards the innovation and a decision. Implementation includes initial implementation and then continued-sustained implementation. The implementation stage is described as: "…*concerned with the actual utilization of the innovation by organisational members as they perform their tasks*". Implementation here is a broad term focussing on the time at which the product innovation is taken up by the customer. Zaltman *et al.*'s (*ibid.*) model is suppler centric however and does not model the customer organisation as well.

Implementation is defined differently in the Tidd *et al.* (2005 pp88-97 Figure 6) model, where they use the term to focus on turning ideas into a product reality and launching to a customer. Launch in this case would include adoption for example, so the use of the term implementation is broader. Tidd *et al.* (*ibid.*) describe how it involves drawing together knowledge acquired from different sources inside and outside the organisation, determining whether the innovation is possible and a specification of characteristics, launching the innovation to the market involving awareness, trial, evaluation and adoption, then using further information to refine it (Rothwell & Gardiner 1988).

As discussed above, innovation is an inherently inter-organisational process and this is true of the implementation part of the process where the product is taken up for use from the supplier by the customer, with implications for how performance is measured and managed. The interaction approach to studying inter-organizational relationships provides some contextual details that are of use in understanding the innovation process. The early research of the IMP Group produced the interaction model (Figure 7, IMP Group 1982), consisting of the organisations and individuals on both customer and supplier sides, the interaction process, the atmosphere of the interaction and the environment in which the interaction takes place. The interaction includes recognition of both short term exchange episodes, or transactions, as well as the longer term relationships that develop as institutionalisation and adaptations occur with repeated transactional relationships. Product, service, information, financial and social exchanges (Ring & Van de Ven 1992, Wilson & Jantrania 1994) may all occur. It is recognised that the individual actors within each organisation have their own aims and experiences that have an influence on the interaction between them and their organisations and the environment is modelled as involving a social system amongst other elements. The atmosphere of the interaction process involves power and dependence of the relationship, expectations of the organisations and individuals, as well as closeness and co-operation. Including the atmosphere in the model also shows that the interaction approach takes account of extra-organisational phenomena, consistent with contemporary open models of innovation.

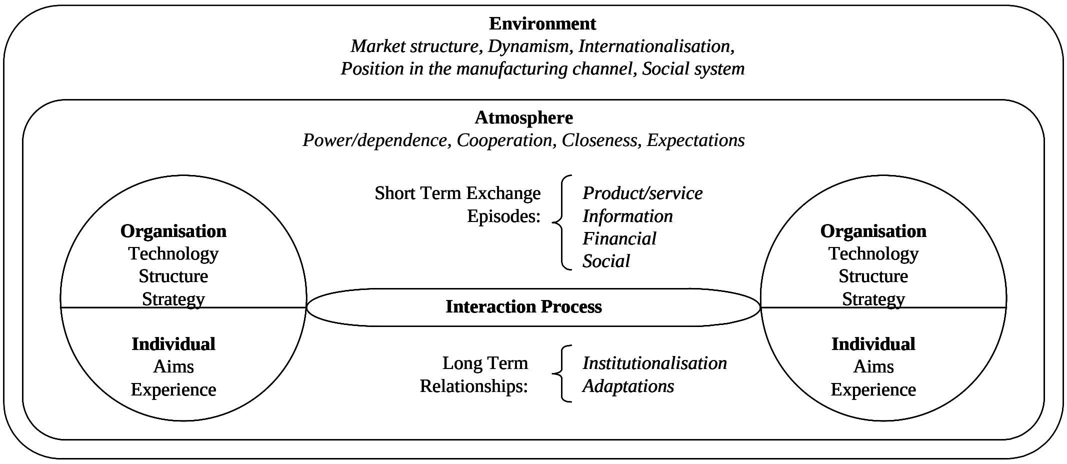

Figure 7. IMP Interaction Model of Inter-organisational Relationships. IMP Group 1982. An Interaction Approach. In: Hakansson H. (Ed.) 1982. *International Marketing and Purchasing of Industrial Goods.* Wiley. Chichester. UK. Chap 2. pp10-27, Figure 2.2.

Relationships have been conceptualised as the building blocks of networks (Ford & Hakansson 2002) or being embedded within networks (Granovetter 1973), which are defined as *"…sets of connected exchange relationships between actors controlling business activities…"* (Cook & Emerson 1984). The definition brings out key network concepts of actors, connections and exchange. Hakansson (1987 pp3-6) conceptualises networks as consisting of actor, activity and resource elements which are mutually interdependent. Relationships and networks of relationships are created as organisations construct actor bonds, activity links and resource ties. These network concepts influence the way organisations and relationships operate and are of relevance to understanding performance measurement, performance management and innovation. For example, Granovetter (1973) describes how organisations use ties to other organisations to exchange information and resources to gain and maintain competitive advantage. A number of terms have been used in the existing literature to describe the various types of inter-organisational relationships. 'Supply relationships' have a particular focus on the structures and processes of the inter-organisational supply of products or services (Harland *et al.* 1999, Lamming 1996), making them most appropriate for this research.

The literature also provides a more explicit discussion of innovation from an inter-organisational perspective, with relevance for performance measurement and performance management. Hakansson (1987 pp3-6) advocates that technological innovation must take place between and not just within organisations and that an innovation is the product of interaction between two or more actors in a network. As part of implementing the innovative product, organisations are involved in knowledge development, resource mobilization and resource coordination (Hakansson *ibid.*). Knowledge development sees organisations interacting to share information on technologies or solutions that may be useful to the other, particularly where a customer and supplier are concerned, with novel ideas often occurring at the interface between organisations. This point is reminiscent of the role of information about the performance of a product as described in the performance measurement literature above. In accordance with social and informational exchange, Nohria (1992) pointed out social interaction as a process that occurs in networks of relationships, developing weak ties (Granovetter 1973, 1985) for the exchange of information (Uzzi 1997) about products. Indeed networking, involving numerous supply relationships between customer and supplier organisations is increasingly the way that organisations go about the process of innovation (Grandori & Soda 1995). Resource coordination in diverse networks of organisations such as firms, research institutes, universities and government bodies, is necessary to gain information and knowledge as contemporary organisations are increasingly specialised (Bessant 1999). This agrees with advanced models of innovation suggested by Rothwell (1992) and Schoen *et al.* (2005), with many linkages and opportunities for communication or social exchange and the flow of information between organisations. Much social and information exchange occurs in informal networks, in addition to formal networks (Allen *et al.* 2007).

Key amongst information exchanges are feedback or learning loops from various stages of innovation process models, particularly from the end of the linear process where the innovative product has been launched to the customer. Feedback involves knowledge development, to learn about the innovative product and adapt it, as part of the iterative process of improving the design of the product (Tidd *et al.* 2005 pp88-97, Biemans 1992 pp129-140, Basadur & Gelade 2006, Schoen *et al.* 2005, Booz *et al.* 1960 pp10-11, OECD 1992 p25). Tidd *et al.* (*ibid.*) also recognise the importance of learning and sustaining activities in innovation, reinforcing the role of feedback. Feedback in innovation is described by Zaltman *ibid.* (1973 pp71-77) as *"…(serving) the process of guiding and controlling the actual performance of a process"* though he points out that *"The information that the feedback mechanisms provide must be interpreted to become useful"*.

Rothwell and Gardiner (1985) coined the term re-innovation in which features of the innovative product are revised after the product is launched on the basis of learning from the original generation of the product, creating a new generation of the product (Nonaka & Kenney 1991). Rothwell and Gardiner (1988) refers to the importance of small incremental improvements in re-designing products, these smaller design steps being responsible for the vast proportion of product re-design. Biemans (1992 pp129-140) studied the adoption and diffusion of medical devices in the Netherlands, specifically including a decision making stage of performance review to complete the cycle. Echoing discussion of information exchange above, knowledge management, involving apprehension and then its creative use are stated as an important part of innovation in effective organisations (Basadur & Gelade 2006). Altogether, the literature emphasises a key role for informational and social exchange between customer and supplier organisations in the iterative innovation process, leading to re-starting the innovation process and changes in the product design.

A key element of the implementation part of the innovation process involving performance measurement and performance management is making the decision to purchase or supply the product. Harland *et al.* (2004) and Grandori and Soda (1995) highlighted the process of decision-making in networks of relationships. According to Harland *et al.* (*ibid.*), decision-making involves combining information with objectives, resolving differences and the establishment of procedures, routines and rules. Johnston and Lewin (1996) conducted a substantial review of organisational buying behaviour literature, describing how Webster and Wind (1972 pp12-39) and Sheth (1996) amongst others developed the general constructs of organisational buying behaviour and influencers. Webster & Wind (1972 pp12-39, 77-107) modelled buying behaviour by organisations and constituent individuals, describing how groups of individuals collectively make decisions in a buying centre or committee. Their model describes how the organisation communicates and searches for information as part of the buying process, again highlighting the role of social and information exchange. The organisational decision making process they describe in the buying process includes establishing objectives and specifications, identifying buying alternatives and evaluating alternative buying actions.

The decision making process of individual buyers is described as similar to that of organisations as a whole, featuring the identification and evaluation of alternatives followed by a choice. Webster and Wind (*ibid.* pp88-107) describe how buyers have a variety of predispositions, preferences and decision models, influencing the outcome of the individual's decisions as shown in Figure 8. The decision making process can be made in both formal and informal ways. The former involves looking at hard criteria such as costs and making a decision in a formal tender process for example. Softer or less tangible aspects of the decision making process include those that are environmental, organisational and interpersonal (Webster & Wind *ibid.*). Decisions may be based on a single dominant dimension such as a financial performance measure, or upon multiple attributes of a particular purchase, using the information gained from performance measurement, as described above. Various weighting and scoring processes may be used where multiple criteria are considered (Van Weele 2002 pp52-59). However decisions may not always be made according to strict procedures, as factors such as the role of expert power, information power and reward power may affect individual influence in the buying centre (Kohli 1989). Berkowitz (1986) describes how product sampling by end users or technical staff gains their interest, yet may not always result in sales, while Nutt (1984) highlights that decisions may be made in the same pattern as previous decisions.

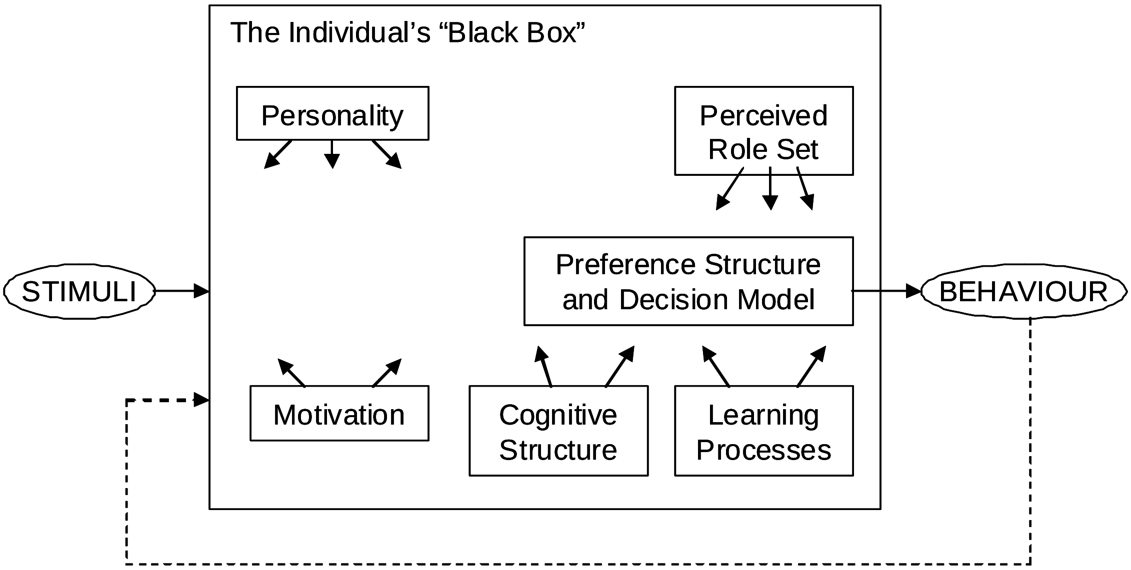

Figure 8. A Simplified Model of Individual Buying Behaviour. After: Webster F.E. & Wind Y. 1972. *Organisational Buying Behaviour.* Prentice Hall. Englewood Cliffs. NJ. USA. pp88-107.

The innovation literature also discusses decision making by customers and suppliers in the implementation part of the innovation process, through concepts such as adoption and diffusion. Adoption is defined by Rogers (2003 p21) as: *"The decision to make full use of an innovation as the best course of action available"*. Adoption of an innovative product is only one option, which gives rejection as the term for the opposite action (Biemans 1992 pp42-45). Biemans points out that rejection may occur at any stage of the innovation process, not only when the product is fully developed and being marketed. Adoption is a similar term to diffusion, which is by contrast defined as: *"Communicating an innovation through certain channels over time among the members of a social system"* (Robertson 1971 p32). They are differentiated as adoption is an individual decision making process, while diffusion represents a wider series of adoption decisions by a number of individuals within a system or network. The concepts describe the decision or decisions to purchase an innovative product from a supplier, by an individual or a number of individuals in an organisation. Biemans (1992 p48) gives an example of activity stages in the buying process, as a description of adopting an innovative product. The stages include gathering information about different options, analyzing it, then making a selection. Rogers (2003 pp169-194)' model is from a diffusion perspective and also includes similar key stages. Overall these stages of gathering information, comparing options against criteria then making a decision concur with those suggested by Webster & Wind (1972 pp12-39, 77-107) above.

Table 16 summarises the main stages in the decision making processes discussed in this section. Overall broad stages of gathering information, analysis and taking the decision are identified. Again social and information exchange is involved, but also product and financial exchange when the purchase decision is made and the innovative product is supplied to the customer. The next section summarises the review of the existing literature.

2.8. Summary

This chapter reported the findings of reviewing existing literature in the performance field. It found that performance is a loose concept drawing on a variety of literatures. In the loosest sense, performance refers to the effectiveness of some sort of achievement or attainment of a variety of things, including innovative products. Also, the performance of the product may affect how the organisation performs. The literature describes financial and broader operational aspects of performance at different parts of the operational process, according to different stakeholders.

Performance measurement is a key concept in the performance literature, which has focussed on the appropriate selection and implementation of measures. However there is an acknowledged lack of clarity in differentiating the concept of performance measurement from performance management, another term widely and loosely used in the literature that refers to broader, or follow up planning and control processes than measurement. Existing work, and increasing interest in whether performance measurement is worthwhile, also suggests that performance management could be differentiated from performance measurement by their having different influences on performance. The literature emphasised that a variety of organisations and individual actors measure and manage performance.

Source or Model	Focus of Literature	Main Stages
Webster and Wind (1972 pp12-39)	General model of organisational buying decision process	1. Identification of need 2. Establishing objectives and specifications 3. Identifying buying alternatives 4. Evaluating alternative buying actions 5. Selecting the supplier
Harland *et al.* (2004)	Decision-making process issues in networks of supply relationships	• Combining objectives and information • Resolving differences • Establishing procedures, routines and rules
Bunn (1993)	Created a taxonomy of approaches to buying decisions according to different buying situations. The different approaches make various use of the activities shown here	• Search for information • Use of analysis techniques • Proactive focus • Procedural control
Nutt (1984)	Types of organisational decision making processes, described using framework of the following stages	• Formulation • Concept development • Detailing • Evaluation • Implementation
Biemans (1992 p48)	Activity stages in the buying process, as adoption of an innovative product	1. Anticipation or recognition of a problem and solution to it 2. Characteristic and quality determination for the item needed 3. Characteristic and quality description for the item needed 4. Searching for and qualifying potential sources 5. Proposal requisition and analysis 6. Proposal evaluation and supplier selection 7. Order routine selection 8. Feedback on performance and evaluation
Rogers (2003 pp169-194)	Innovation decision process from a diffusion perspective	1. Knowledge (Including: *Recall of information, comprehension of messages, knowledge or skill for effective adoption*) 2. Persuasion (*Liking the innovation, discussion of new behaviour with others, acceptance of message about the innovation, formation of positive image of message and the innovation, support for innovative behaviour from system*) 3. Decision (*Intention to seek additional information about the innovation, intention to try the innovation*). Decision is for adoption or rejection, immediately and also longer term when it may change. 4. Implementation (*Acquisition of additional information about the innovation, regular use of the innovation, continued use of innovation*) 5. Confirmation (*Recognition of benefits of using innovation, integrating the innovation into an ongoing routine, promoting the innovation to others*)

Table 16. Summary of Main Stages in Purchasing and Supply Decision Making in the Purchasing and Supply Management and Innovation Literatures

Discussion of existing literature on the implementation of innovative products, the context of this research, highlighted that innovation is a process, involving customer and supplier individuals and organisations for success. Between these, social, informational, product and financial exchange occur as part of the implementation part of the innovation process, including performance measurement and performance management, including where decision-making is involved. This research focuses on technological innovation and innovative products, given the focus on medical devices. It concentrates on the implementation part of the innovation process where the supplier's product is developed, launched in the market and learning through feedback occurs.

Key questions about performance measurement and performance management during the implementation of innovative products that were raised by reviewing the existing literature are now taken forwards in the next chapter. It develops research questions and uses the findings of the literature review as a basis for conceptualization of this research.

CHAPTER THREE: RESEARCH QUESTIONS AND CONCEPTUAL FRAMEWORK

3.1. Introduction

The last chapter examined the literature on performance and analyzed differences between the concepts of 'performance measurement' and 'performance management', observing the influences that the literature implies that they may have. This performance literature has implications for understanding performance measurement and management of innovative products during their implementation. The literature review also discussed the innovation process and the implementation of innovative products such as medical devices.

This chapter continues the thesis by outlining a set of research questions that emerged from the literature review and were refined during the iterative process of the research as a whole. Towards development of a conceptual framework, the chapter continues by discussing differences between the concepts of performance measurement and performance management in the supply of innovative products. This work is based on the publications described in the literature review, but is more focussed for this research in the light of the research questions. The chapter also discusses conceptualisation of the influences of performance measurement and performance management and determines the most appropriate part of the innovation process for study in this research. Based upon these background concepts, the chapter finishes by presenting a conceptual framework, upon which the empirical work of the thesis was carried out.

3.2. Derivation of Research Questions

The literature review gives rise to the following over-arching research question, based on the original research aim:

- How is the performance of innovative healthcare products measured and managed during the implementation process and what influence do these processes have on their performance?

The question draws on the limited conceptual clarity over performance measurement and management, as well as the increasing interest in the purchasing and supply of innovative products. This over-arching research question is broken down into the following sub-questions, summarised in Table 17 with details, examples of their basis in the literature and a note towards the answer strategy, discussed further in the methodology chapters.

Research Question	Question	Explanation	Example of Literature Basis	Answer Strategy
A	**What processes are used to measure and manage the performance of innovative healthcare products during their implementation?**	The literature review suggested that a range of processes may be used to measure performance and manage performance. Further, existing work shows that there is often a lack of conceptual clarity in distinguishing the two concepts. This question explores what processes are used to measure and manage the performance of innovative products such as medical devices, by the variety of actors involved in their implementation.	Neely *et al.* (2005), Globerson (1985), Radnor & McGuire (2004)	Case study, pattern matching & cross-case synthesis
B	**How do the processes used to measure and manage the performance of innovative healthcare products during their implementation influence their performance?**	The literature contains limited and conflicting evidence on the influence of performance measurement on performance. Indeed some research suggests that only performance management processes influence performance, not performance measurement processes alone. This question investigates if and how the performance measurement and performance management processes identified in question A influence performance of the innovative product.	Davis & Albright (2004), Ittner *et al.* (2003), Banker *et al.* (2000), Perera *et al.* (1997), Neely *et al.* (2004), Bourne *et al.* (2005), Hume & Wright (2006), Kaplan & Norton (1992,1996), Neely (2004), Ridgway (1956), Globerson (1985), Webster & Wind (1972 pp89-106), Halachmi (2005), Pfeffer & Sutton (2006), Robson (2005)	Case study, pattern matching & cross-case synthesis
C	**How should performance measurement and performance management processes during the implementation of innovative healthcare products be differentiated?**	The literature review highlighted a lack of a clear conceptual distinction between performance measurement and performance management. This question builds on the findings of the previous two questions by investigating whether performance measurement and performance management processes can best be distinguished from one another by either the latter being broader, or influencing performance.	Radnor & McGuire (2004), Halachmi (2005), Lebas (1995), Neely *et al.* (1997), Melnyk *et al.* (2005), Bourne *et al.* (2005)	Case study, pattern matching & cross-case synthesis, explanation building

Table 17. Details, Literature Background and Answer Strategy for Research Questions

- **Research Question A:** *What processes are used to measure and manage the performance of innovative healthcare products during their implementation?*

The literature review suggested that a variety of processes may be used to measure performance (Neely *et al.* 2005) and manage performance (Globerson 1985) by various organisations and individuals. Further, existing work shows that there is often a lack of conceptual clarity in distinguishing the two concepts (Radnor & McGuire 2004). This research question explores what processes are used to measure and manage the performance of innovative products such as medical devices, by the variety of actors involved in their implementation.

- **Research Question B:** *How do the processes used to measure and manage the performance of innovative healthcare products during their implementation influence their performance?*

The literature contains limited and conflicting evidence on the influence of performance measurement on influencing performance with some existing work suggesting there is an influence (Davis & Albright 2004, Ittner *et al.* 2003b, Banker *et al.* 2000) while other work suggests there is not (Perera *et al.* 1997, Neely *et al.* 2004). It suggested that performance measurement alone cannot alter performance (Bourne *et al.* 2005, Hume & Wright 2006) and is intrinsically reflective (Kaplan & Norton 1992), yet also that it may have value to organisations in a variety of other ways (Neely 2004) and can even have dysfunctional consequences (Ridgway 1956). The literature describes performance management processes that influence performance (Kaplan & Norton 1996, Globerson 1985, Webster & Wind 1972 pp89-106). Indeed some research suggests that only performance management processes influence performance, not performance measurement processes alone (Bourne *et al.* 2005, Globerson 1985, Halachmi 2005, Pfeffer & Sutton 2006). In response to this literature, the question investigates if and how the performance measurement and performance management processes identified in question A influence performance of the innovative product.

- **Research Question C:** *How should performance measurement and performance management processes during the implementation of innovative healthcare products be differentiated?*

The literature review highlighted a lack of a clear conceptual distinction between performance measurement and performance management (Radnor & McGuire 2004). Previous work suggests that performance measurement is a sub-set of broader performance management (Halachmi 2005, Lebas 1995) involving follow up planning and control action to performance measurement; or that performance management influences performance, whereas performance measurement does not (Halachmi 2005, Bourne *et al.* 2005). This question builds on the findings of the previous two questions by investigating whether performance measurement and performance management processes can be distinguished from one another by the latter being broader, or influencing performance.

The questions underpinned empirical data collection in this research. Given the limited existing work in the area in the literature review, their focus is largely exploratory, with question A focussing on gaining insights into processes that occur and question B exploring the influences of those processes. Question C takes a more explanatory approach, trying to clarify the concepts identified in the literature review with the use of empirical data. The research questions raise some conceptual issues towards development of a conceptual framework, which are discussed in the next section before a conceptual framework is presented at the end of this chapter.

3.3. Conceptual Development

This section builds upon the findings of the literature review by developing concepts for use in a conceptual framework for this research. The following sub-sections discuss a focus for this research within the broad innovation process, conceptualisation of performance measurement and performance management with respect to one another and finally some details about conceptualizing the influences of the processes on performance.

3.3.1. Focus of this Research Within the Innovation Process

The literature review showed that innovation is modelled as a broad process from detecting signals of change in the environment, through to sustaining an innovation, learning and re-innovation (Tidd *et al.* 2005 pp88-97). The breadth of this innovation process has caused researchers to limit their studies to a particular part or phase of the innovation process, some of these phases having been described in the literature review.

The early part of the innovation processes are not applicable for this research, as they frequently focus on innovations in early development, that can actually be defined as inventions, as they have not been exploited yet. Similarly, the new product development literature also focuses on the earlier parts of the innovation process rather than products already in use by the end user. However the term has also been used in research that includes and is of interest to the innovation process in general so some of these publications will be relevant to the thesis. Innovation has been described as broader than new product development, from identifying market needs to sales (Trygg 1991 p4). The importance of viewing innovation as an inter-organisational process is recognised (Ritter & Gemunden 2004, Chapman & Corso 2005, Grandori & Soda 1995) so this research has also drawn on research in the purchasing and supply management field. It focuses on supply relationships between suppliers and the NHS as an end customer, so the latter parts of the innovation process are of more interest.

Implementation as defined by Tidd *et al.* (2005 pp88-97) was found to be the broadest term describing the latter parts of the innovation process, recognizing the inter-organisational context, where the supplier turns ideas into a product reality, exploitation in launching it to the market where the customer utilises it and finally sustaining the innovation with feedback. However it does not go to the breadth of also covering invention and idea generation in the early stages of the innovation process overall. It enables study of the performance measurement and management processes during the latter stages of innovating, purchasing and supplying innovative products that have already been introduced commercially (Saren 1984).

The literature review covered different conceptual approaches to the inter-organisational relationships and networks in the innovation process. The interaction approach (Ford *et al.* 1986, Ford & Hakansson 2002) is the most illuminating for this research as it is broadly based, recognises both customer and supplier as active parties, has been used in innovation and purchasing and supply research and allows study of the more developed, longer-term relationships that can occur in the product innovation process. Different types of relationships and networks were also discussed in the literature review and this research refers to supply relationships and supply networks (Harland 1996), as the concept concentrates on inter-organisational purchasing and supply of product service offerings. As a whole, this research draws principally upon the operations and supply strategy literature, which has made use of the interaction approach in its development (Harland 1996).

3.3.2. Conceptualizing Performance Measurement and Performance Management

As discussed in the literature review, existing research as a whole has not drawn a clear and consistent distinction between the concepts of performance measurement and performance management. While the research questions and especially question C set out to empirically explore this area in the context of this research, some form of conceptualisation of the two concepts with respect to one another is required for developing a conceptual model on which the empirical work is based. A working definition of the concepts is then given.

Performance measurement and performance management are typically modelled as processes (Neely 1997, Halachmi 2005), consisting of actors such as the organisations and individuals involved in the interaction, activities for example social exchange and resources such as measures themselves. Much existing work suggests that performance management consists of a broader range of processes than performance measurement (Halachmi 2005, Globerson 1985, Radnor & McGuire 2004). Lebas (1995) is in agreement with this, graphically modelling performance measurement as a subset of performance management in two ovals, one nesting inside the other. However the literature is not clear about the relationship between the two spheres, with Lebas (*ibid.*) stating that performance management precedes performance measurement, whereas other literature suggests performance management involves processes that follow up, or are subsequent to performance measurement (Radnor & McGuire 2004, Globerson 1985). Examples include management making decisions on the basis of information (Pfeffer & Sutton 2006). Although stating that performance management has preference, Lebas (*ibid.*) also suggests that measurement and management occur in iterative cycles. A conceptualisation of performance measurement as a subset of a range of broader, performance management processes is used in this research, as shown in Figure 9, a simplified and modified version of Lebas (1995)' diagram distinguishing the two concepts. The diagram is simplified as it is without any arrows showing precedence, which is not clear from the above literature and will be explored empirically. It shows performance measurement as a subset of, so included within, broader performance management processes as suggested by the literature (Halachmi 2005). The diagram here shows the larger oval and everything within it as performance management processes, in this research these are planning and control management processes in the implementation of innovative products. These performance management processes include the performance measurement processes in the small oval. The area within the large oval but not taken up by the small oval represents those parts of management processes other than measurement.

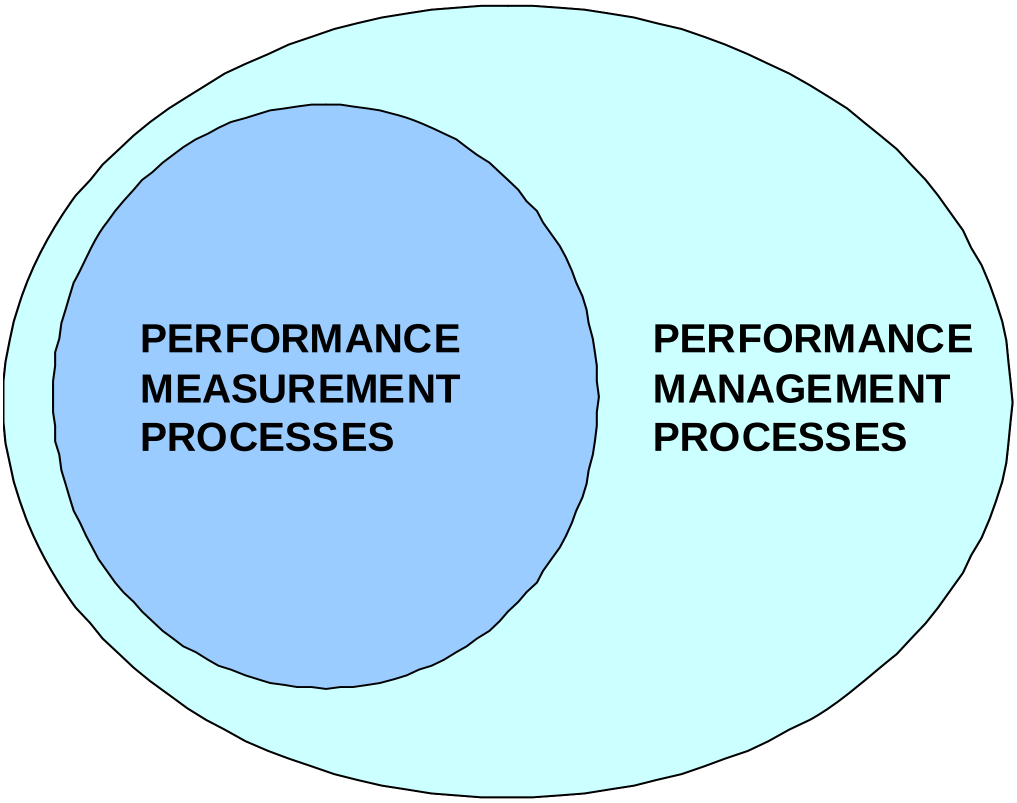

Figure 9. Conceptualisation of Performance Measurement and Performance Management with Respect to One Another. After: Lebas M.J. 1995. Performance Measurement and Performance Management. *International Journal of Production Economics.* 41(1-3) pp23-35. Fig 9.

Further to conceptualizing performance management as a broader set of processes than performance measurement, some existing literature suggested that a difference can be drawn between the two concepts by their influence or otherwise on performance (Bourne *et al.* 2005, Halachmi 2005, Kaplan & Norton 1996). Research questions B and C explore this issue empirically, and can be represented in a conceptual framework by recognising that the concepts of performance measurement and performance management may influence performance. This conceptual issue is addressed in the next sub-section.

Based on the literature review and conceptualisation, working definitions of performance measurement and performance management are given here, to be taken forwards in the empirical work.

Performance measurement is defined as: *Quantifying or qualifying an aspect of the performance of a product*. This definition draws on Neely *et al.*'s (2005) definition and reflects the fundamental concept of measurement as described by Farbey *et al.* (1993 pp75-94), though has been altered to recognise literature suggesting that measurement can be qualitative as well as quantitative. Also the Neely *et al.* (*ibid.*) definition has been altered to focus on measuring performance of innovative products (Zheng Zhou 2006) rather than events or processes.

Performance management is described as: *Broader or follow up planning and controlling action, based on information from performance measurement, which influences the performance of a product*. Based upon Radnor and Barnes' (2007) suggestions of actions aimed at improvement, this definition includes the concept of management as involving planning and control actions (Mintzberg & Lampel 1999, Slack *et al.* 2007 p24-25). It highlights how these actions may involve using information from performance measurement (Globerson 1985, Lebas 1995) which is a part of performance management. The definition also reflects two key ways the literature suggests the concept can be differentiated from performance measurement, namely that it is broader or involves follow up action (Halachmi 2005, Lebas 1995), or that it influences performance (Bourne *et al.* 2005, Halachmi 2005, Melnyk *et al.* 2005).

3.3.3. Conceptualisation of the Influences of Processes in Performance

This sub-section discusses concepts in the literature that underlie description in the research questions and conceptual framework of the roles of performance measurement and management processes. It describes why the focus of this research is on the influences of the processes in performance rather than on performance and outlines why the term 'influence' was used. However, it then discusses the different aspects of performance that might be measured or that the processes may influence, with a view to implementing concepts of performance measurement and process roles in the empirical work.

A number of studies have investigated the link between various ways of managing an operation and an aspect of performance, though most tend to be positivistic economics or operations research type studies (Hendricks & Singhal 2003). This has limited relevance for this research, also as the literature review highlighted that performance is a loose and broad concept that can be applied to a variety of things and that a variety of aspects of it can be measured. On the other hand, where operations management studies in the performance field have discussed performance, they focus mostly on the implications or influences of performance measurement or other operational processes and interventions. For example, Radnor and McGuire (2004) studied the effectiveness of performance management in the public sector by focussing on the influence of the systems rather than on links to performance. Similarly, many publications in the innovation field have studied the performance of processes (Owens 2007). Such influences are often only suggested and again refer to a variety of aspects of performance. In the light of the existing research in the area this research focuses on the influences of performance measurement and performance management processes, rather than upon making links to performance, as reflected in the work in the *Journal of Productivity and Performance Management* for example.

Whereas other terms such as ‘link’ (Gloor *et al.* 2008), ‘cause’ and ‘connection’ are usually found in conclusive, positivistic studies, ‘influence’ has been used in case-based research that deals with exploring concepts and building explanations (eg Garengo & Bititci 2007), so is chosen as being more appropriate for this research. Choosing the term ‘influence’ is also inclusive of both positive and negative roles discovered in the empirical work, if the processes are found to have a beneficial effect on performance or a non-beneficial effect, hindering performance (Ridgway 1956). Other existing research has referred to impacts on performance, however the term has been used where performance outputs are more clearly defined in terms of high performing and average performing business units (Bourne *et al.* 2005), rather than influence which is more exploratory.

Although the focus of the research is on the influences of performance measurement and performance management, rather than performance, a conceptualisation of performance is useful in developing the empirical tools, to describe what aspects of performance are being measured and managed and provide a background to what sort of influences might be discovered. Reviewing the literature showed a breadth of different conceptualisations of performance in existing work, either in the way performance was described or empirically measured. For example Ahmed and Zairi (2000) reviewed literature with a number of performance concepts in the product innovation field. They discovered financial and operational performance concepts from customer, technological and product viewpoints. Concepts of performance used in existing literature were described in the previous chapter, along with a description of the study concerned and how the concept of performance was implemented empirically. Kaplan and Norton (1992) amongst others state that a mixture of financial and non-financial measures is important. Also, the recent evidence-based and healthcare related literature suggests that a conceptualisation of performance which recognises quality of care or life for the patient is necessary (Sackett *et al.* 1996). Whereas the literature review studied concepts of performance in general, here the focus is on how such concepts are applied empirically, with the interest of developing a concept of performance for a conceptual framework in this research.

Griffin and Page's (1996) concept of performance on three dimensions is the most appropriate for this research, as it meets the requirement to be sufficiently broad, taking account of financial and non-financial measures (Kaplan & Norton 1992), includes three dimensions that are consistent with other works in the literature (Hultink *et al.* 1997, Song *et al.* 1997) and is specifically from an innovation relevant context. The existing literature on performance shows publications that conceptualise performance of a wide variety of things that may perform, from the organisation (Ritter & Gemunden 2004) to products (Tidd *et al.* 2005 pp561-569). The Griffin and Page (1996) framework is useful for this research as it takes product development, a concept closely aligned with innovative products as the unit of analysis in this research, yet also recognises that the performance of that product can be expressed in terms of the way it performs in the market place and financially for customer and supplier organisations. Griffin and Page (1996) summarises the performance concept and so can be used to describe the influence of the processes in financial, technical and customer performance and also to refer to financial, technical and customer performance measures.

The concepts developed so far in this chapter are used to develop the conceptual framework, which is presented and described in the next section, as well as to operationalise the research, discussed in the next chapter.

3.4. A Conceptual Framework

The conceptual framework was developed based upon the literature review and the research issues and questions arising from it. The framework has developed iteratively, along with the concepts that are a part of it, which were discussed in the previous section. This section presents the framework as shown in Figure 10, which underpins the empirical work, while subsequent chapters present the methodology used.

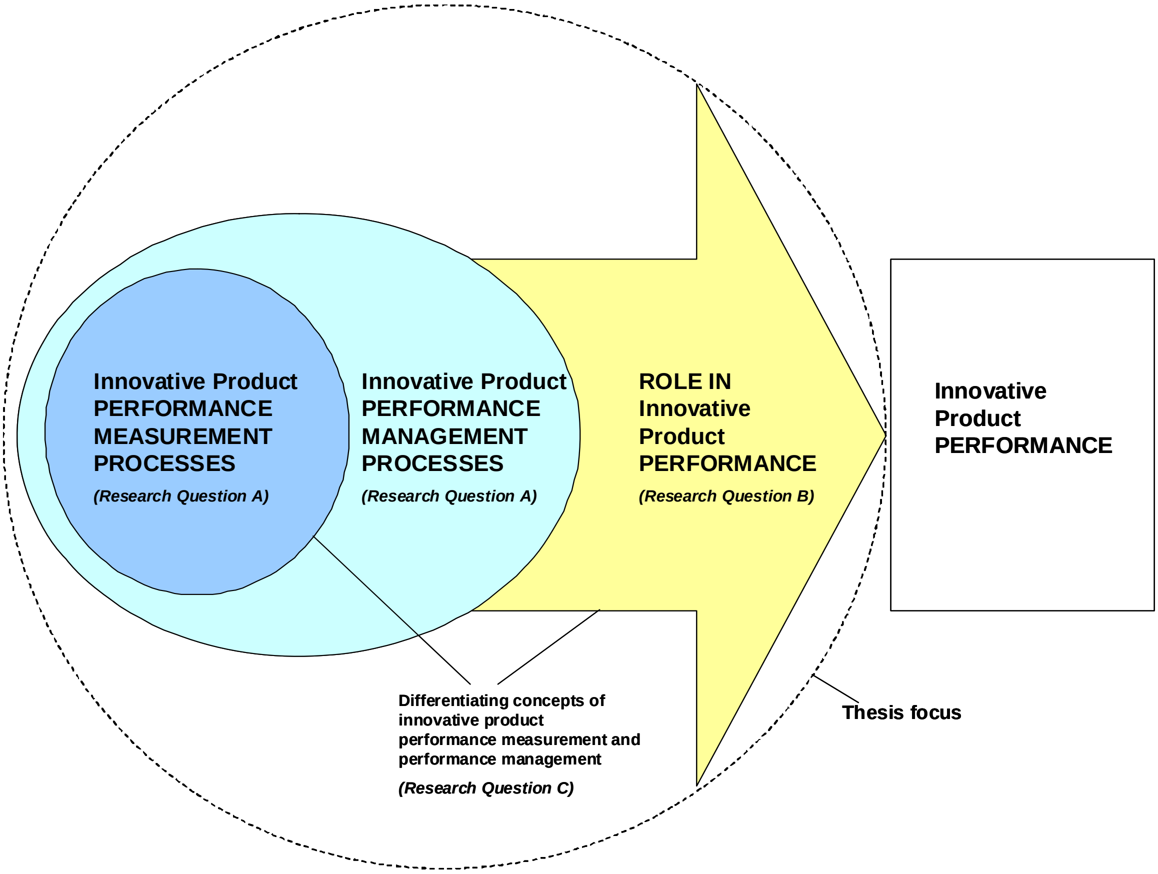

Figure 10. Conceptual Framework

Figure 10 shows that the conceptual framework is structured around a core of the performance measurement and performance management processes, represented by the two ovals, one nested inside the other. The ovals represent performance measurement processes as a sub-set of broader performance management processes, in the manner of Lebas (1995) and Bititci *et al.* (1997). As described above, the ovals show performance measurement as a subset of performance management, in the light of the literature describing performance management as broader than performance measurement (Halachmi 2005). A simplification from Lebas' diagram is that precedence of one set of processes is not shown. A clear division between performance measurement and performance management is shown, as in the Lebas framework and definitions above.

The influences of the performance measurement and performance management processes are also included in the framework, as the literature also suggests the two concepts may be differentiated by their influence or otherwise in performance. The influences are represented using an arrow, leading to performance of the innovative product which is shown using a square. Different shapes are used to show that the influences of the processes above and performance do not represent processes like the ovals. The arrow runs to performance from both of the ovals shown in the framework, as the empirical work studies whether performance measurement alone or broader performance management processes influence performance. The dotted circular line represents the focus of the thesis on the performance measurement and performance management processes and their influences, rather than conclusive links between the processes and performance.

The conceptual framework must be accompanied by a definition of the unit of analysis used in the empirical work, the innovative product. The unit of analysis is described in the later methodology chapter, but is included in the framework which illustrates processes that measure and manage the performance of the innovative product, as well as a representation of influences of those processes in performance of the innovative product.

The conceptual framework aids answering the research questions as follows. Question A explores the performance measurement and performance management processes of innovative products during their implementation, which the empirical work will address by investigating the processes that occur within the small and large ovals. Diagrammatically, Question B is represented by the arrow showing the influences of the processes in the ovals on performance, the question investigating if and how the influence shown by the arrow is found empirically. Together, Questions A and B aid answering Question C, by examining whether performance measurement and performance management can be distinguished conceptually by either the former being a subset of the latter, or by their influence on performance. Question C is represented on the framework as it illustrates two key ways the literature suggests that performance measurement and performance management can be differentiated; firstly by showing performance management as broader or follow up planning and control processes than performance measurement, and secondly by their influence or otherwise on performance. These concepts are used later in the thesis to structure the analysis, discussion and to draw conclusions. The next section summarises the development of research questions and conceptualisation of the framework, before the following chapter discusses methodology for the empirical work.

3.5. Summary

This chapter has presented research questions for the thesis, based upon the issues raised in existing research covered in the literature review. Focussing on the implementation of innovative products, questions explore the performance measurement and performance management processes used, how these processes influence performance and how performance measurement and performance management processes could be differentiated. These questions pick up on the interest in inter-organisational innovation, as well as challenges in managing the purchasing and supply of innovative products. In particular, the questions explore conceptual issues from the literature review that there is a lack of clarity over performance measurement and performance management concepts, and the conceptual and practical problem of determining whether performance measurement and management are worthwhile.

The research questions raised some conceptual issues which were addressed as part of developing a conceptual framework. These include concentrating on the implementation part of the innovation process and identifying a working conceptualisation of performance measurement and performance management. Given the state of existing work, it was decided to conceptualise the influences of the processes on performance, rather than performance and links to the processes. These concepts were presented in an iteratively developed conceptual framework which underpins the empirical work.

The next chapter discusses research philosophies and methodology, identifying and discussing the most appropriate choices for pursuing the research questions.

Part Two: Research Process & Empirical Findings

CHAPTER FOUR: RESEARCH PHILOSOPHY AND METHODOLOGY

4.1. Introduction

This chapter presents and discusses the research philosophy and methodology used in the thesis. It starts by outlining various possible philosophical and epistemological positions, before providing a discussion of the chosen interpretivist philosophy. In line with the selected philosophy, the chapter continues to discuss the abductive strategy taken in the research. The strategy in turn dictates the research methodology, which is discussed next, including details on unit of analysis, sampling and data collection. At the end of the chapter details are given on data analysis and interpretation, including a discussion of research credibility.

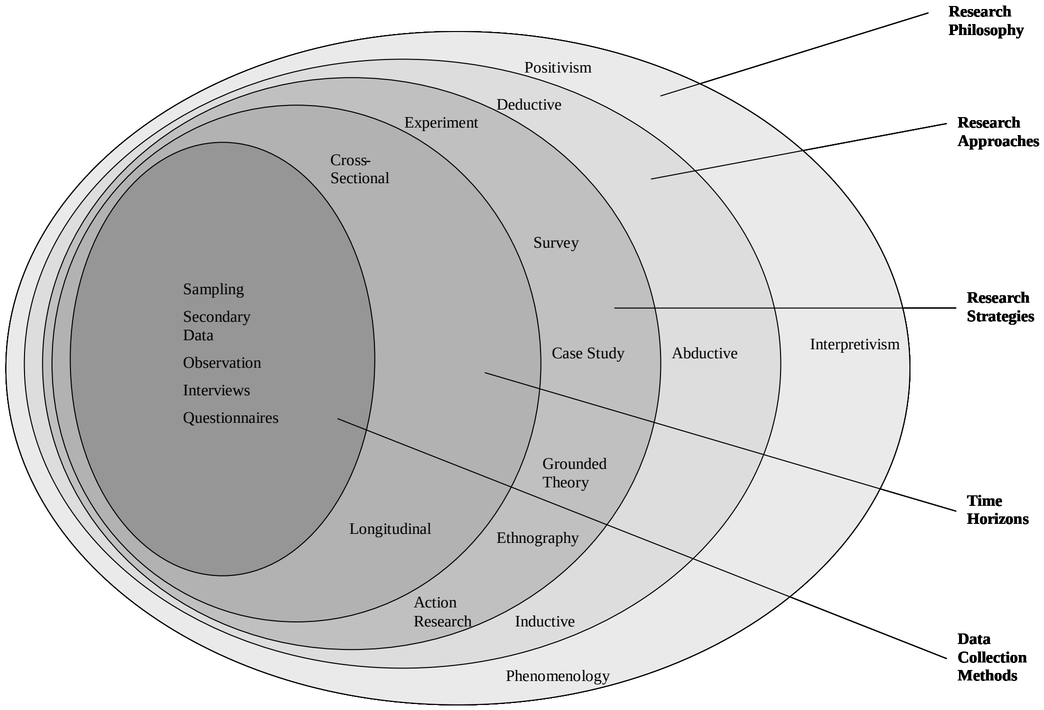

Figure 11. The Research Process 'Onion'. After Saunders M. Lewis P. & Thornhill A. 2000. Research Methods for Business Students (2nd Ed.) F.T. Prentice Hall. Harlow p83.

4.2. Research Philosophy and Epistemology

The epistemological stance taken depends upon the view of how the knowledge creation process of research occurs in practice. The ontological position that is associated with and underlies the epistemological stance describes the view taken of reality and the role of knowledge regarding that reality. A variety of ontological and epistemological stances have been taken in existing research in the fields of performance, innovation and organisations, though Ramsay (1998) points out that there has been minimal discussion of research philosophy and epistemology in the purchasing and supply literature. Ramsay (*ibid.*) broadly describes two epistemological stances of positivism and interpretivism, similarly Saunders *et al.* (2000 p83, Figure 11) present a spectrum of research philosophies from positivistic to phenomenological, with associated research approaches, strategies and data collection methods. The following sections discuss the two epistemological stances as described by Ramsay (*ibid.*) of positivism and interpretivism with reference to their underlying ontological approach.

4.2.1. Positivistic Approaches

Positivism originates in the study of natural sciences using so-called scientific methods to develop theory through hypothesis formulation and testing (Ramsay 1998 *ibid.*). This involves developing covering laws of cause and effect between parameters of the subject of the research, the laws then being used to explain the natural world, or in this case, the social world (Hume 1888 p87). Facts are emphasised, rather than values and meanings, the laws being assumed to give a definitive explanation. Positivism is described as a mechanistic worldview of closed systems operating like machines, where changes to inputs lead to predictable changes to outputs (Bhaskar 1978 p63-90). Examples of positivistic research in the field of this research include Ritter and Gemunden (2004), who investigated relationships between quantitative measures of innovation performance and strategy using structural equation modelling. The research attempted to gain empirical proof of a hypothesised model of covering laws, with a focus on statistical generalisation (Yin 2003 pp1-18) to a large quantitative sample.

However positivism has been criticised for use in the study of social systems as they are not closed or mechanistic. Bhaskar (*ibid.*) suggests that a closed system is isolated from external influences or any change in the influences, that its internal structure of actors and processes must be constant and finally that performance of the system as a whole must arise as a result of the performance of system components alone. The literature has shown that producing an innovative product is inherently an inter-organisational process (Tidd *et al.* 2005 pp52-55) and that the networks of relationships involved are actually open systems with only an arbitrary boundary for research purposes (Harland *et al.* 2004). Further, a huge number of factors are involved in performance and innovation as shown in the literature review. Additionally the discussion of network competence in Ritter and Gemunden (*ibid.*) implies that external influences are at work, suggesting that use of the positivistic quantitative methods would be at best blunt and forced for this research. Ramsay (*ibid.*) points out that the actors in the research subject are all human and are therefore not uniform, passive and unchanging. They will change as they learn and develop the element of newness that is essential for the innovative product. Ramsay (*ibid.*) and

Sayer (1984 p177) suggest that this ability to generate meaning is not ontologically compatible with a positivistic philosophy. For the above reasons a positivistic stance is very limited in its appropriateness for this research and the next section discusses interpretivist approaches.

4.2.2. Interpretivist Approaches

Whereas positivism assumes that the human actor is uniform and not implicated in the subject of the research, interpretivism is built on the recognition of the human actor and their influence (Ramsay *ibid.*), tending to concentrate more on qualitative data. Interpretivism typically works with qualitative data to generate meanings rather than rules and covering laws and may try and gain analytical rather than statistical generalisability (Yin 2003 pp1-18). Mir and Watson (2001) state that the phenomenon being researched exists only as far as it is interpreted by the researcher, with a lack of ultimate truth. This research studies performance measurement and performance management processes, a topic that has seen different interpretations (Lebas 1995, Halachmi 2005, Bourne *et al.* 2005) and a lack of clarity about what the processes are (Radnor & McGuire 2004). This demonstrates a key principle of interpretivism, that the same research subject is viewed in different ways by different researchers, often giving different results.

However interpretivist stances are subject to criticism for resulting in theories that are not a description of reality, but simply generated by the researcher (Mir & Watson 2001). The open systems involved limit theoretical generalisability of research findings because of a lack of objective data as the philosophical position may influence research findings (Ramsay *ibid.*), such as in the example of the inter-organisational relationships literature above.

While there are aspects of both positivism and interpretivism that limit how appropriate they are for use in this research, an interpretivist stance is more suitable. Although an interpretivist point of view accepts realities that are created by the researcher with limited generalisability, they are not the sort of totally objective, blunt realities of a closed mechanistic system that lead to the above drawbacks in conducting research in this recent and developing field from a positivistic stance. Interpretivism allows some explanation of performance measurement and performance management of innovative products and their influence on performance. An interpretivist stance is also appropriate for the phenomena studied in this research as the organisations, individuals and relationships involved are not closed mechanistic systems. Later on, the chapter describes how some of the shortcomings of interpretivism are mitigated, and the next section continues to develop the methodology by discussing further aspects of the research approach and process.

4.3. Research Approach and Process

The choice of research philosophy is reflected in the aligned research approach and process, examples being shown in Figure 11 (Saunders *et al.* 2000 p83). The key research approaches are found in research in the social science literature as a whole. Firstly a deductive approach (eg Gill & Johnson 1997 pp28-33) advocates theory development before empirical work, which is used to test the theory. A deductive approach fits closely with a positivistic philosophical stance and quantitative data, an example of deduction being theoretical model testing in Ritter and Gemunden (2004). Deduction may be said to produce more objective, unbiased empirical data because of its positivistic alignment. Secondly, an inductive research approach (eg Merton 1957 pp99-101) involves theory development after empirical work and is aligned with a phenomenological standpoint, frequently using qualitative data. An example is the development of the interaction model (Ford *et al.* 1986), showing how inductive research can benefit from serendipitous data and explanations discovered during empirical work in the social sciences.

Just as positivist and interpretivist standpoints both have their drawbacks, so does following a purely deductive or inductive approach. Social science research has often shown aspects of both deduction and induction in research approach, both developing theories from literature that are then empirically tested, as well as refining the theory following empirical work where new data was gathered. Dubois & Gadde (2002) describe this as an iterative research process of systematic combination of existing theories and those discovered through the empirical work. Ayer (1968 p85) agrees, having named this research process ‘abduction’. Abduction is well aligned with the chosen interpretivist philosophy as it both attempts to develop explanations and allows for unexpected findings that arise when researching organisations, individuals, relationships and innovation in open systems. Abduction also offers a truthful and pragmatic description of the overall research process in reality. The following sections continue to describe the research process, focusing on matters of methodology, unit of analysis, sampling and data collection.

4.3.1. The Multiple Case Study Research Methodology

A range of possible research strategies are possible, as shown by the literature review and Saunders *et al.* (2000 p83, Figure 11), with many having a background in a particular philosophical standpoint. The most appropriate methodological strategy for this research is the case study, as it lies in the middle of the philosophical spectrum discussed above and is congruent with the interpretivist stance and abductive research process. Yin (2003 p5) discusses the relevant research situations for different research strategies, as summarised in Table 18.

Strategy	**Form of Research Question**	**Requires Control Over Behavioural Events**	**Focuses on Contemporary Events**
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival Analysis	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case Study	How, why	No	Yes

Table 18. Relevant Situations for Research Methods. After: Yin (2003) *Case Study Research: Design and Methods.* (3rd Ed) Sage. London. UK. p5.

According to Yin (*ibid.*), the case study is an appropriate method for answering the 'how' nature of the research questions, especially as it is not possible to have behavioural control over performance measurement, performance management or innovation, which may be contemporary events when studied empirically. Although surveys have been used to answer 'how' and 'what' questions, they typically do so in a quantitative, positivistic manner which is not appropriate for the exploration of processes in this research. Further justification for selection of a case study strategy comes from their widespread use in the existing literature in the field of this research (eg Kaplan & Norton 1992, Davis & Albright 2004). However Seuring (2008) emphasises the importance of documenting the case study research process carefully in supply management research, as described in the following sections. According to Yin (2003 pp1-18), the case study may be used to answer exploratory 'what' style research questions, as well as for more explanatory research involving 'how' style research questions. Yin (*ibid.*) states that the case study is appropriate for investigating contemporary phenomena within their context in the real world, when the boundary between that context and the phenomena is not clear. In both cases, he describes the case study as beneficial to gaining a holistic understanding of real-life social phenomena that are complex, such as organisational and managerial processes, backed up by Eisenhardt (1989), making the case study appropriate for this research.

Yin (2003 pp19-56) describes a variety of case study research strategies involving single or multiple cases. While a single case study design may be used to test a pre-existing theory for studying unique cases, multiple case study designs are usually preferred as they often provide more robust findings that are easier to generalise. Yin (*ibid.*) advocates replication of cases in a multiple design, so replicating findings between the cases through literal replication, as well as providing the opportunity to contrast cases with different findings for understood reasons through theoretical replication. Hence a multiple case design is used in this research. An important step in each case is defining the unit of analysis, so the next section describes the unit of analysis used in this research. The subsequent section on sampling then describes how the cases were selected.

4.3.2. Unit of Analysis

The unit of analysis chosen for the empirical work is the innovative product. A review of the existing literature shows that previous studies have used a variety of units of analysis. Some examples are given in Table 19 below, modified from Rogers (2003, pp96-98, Table 2.2) work on diffusion of innovation, which shares a focus similar to that on implementation of innovations in this research.

Literature	Topic of Study	Unit of Analysis Used
Fliegel & Kivlin (1966)	Attributes of innovation and rates of adoption	Innovations
Coleman *et al.* (1966, pp113-140)	Patterns in network links between actors and diffusion networks	Dyadic network links
Ryan & Gross (1943, Chaps 5&9)	Characteristics of members of a social system and consequences of innovations	Members of social system / the innovation decision

Table 19. Unit of Analysis in Existing Literature on the Topic (After Rogers 2003 pp96-98, Table 2.2).

The table shows just how wide the choice of possible units of analysis has been in existing research and that the choice is very specific to context. Further, the various types of innovations discussed in previous research discovered in the literature review dictated a difference in unit of analysis in those studies. For example, Utterback and Abernathy (1975) include both product and process innovation in their unit of analysis by referring to technical innovation. Zaltman *et al.* (1973 pp16-31, 52-77) describes innovation as one of three concepts, with implications for unit of analysis. The concepts are:

1. Process of developing a new item (developing unit perspective)
2. Process of adopting new item (adopting unit perspective)
3. New item itself (perspective of product itself)

The three concepts suggest a unit of analysis that is based on either the organisations involved in the implementation part of the innovation process, or on the innovative product, focussing on its implementation. The latter is most suitable for this research as it enables an inter-organisational study, which is important, as innovation is inherently an inter-organisational phenomenon.

The innovative product is chosen for this research. In the chosen healthcare context this is known as a medical device. 'Innovative' implies an element of newness that is exploited (after Tidd *et al.* 2005 pp10-77), describing the necessary elements for definition as a technological innovation. While 'innovative product' focuses on product innovation, the literature shows that there is a blurred overlap between product and process innovation (Tidd *et al.* 2005 pp10-11) with an unclear distinction between the two (Clarke *et al.* 1995), meaning that both will necessarily be studied in practice. For example a new medical device takes the form of a physical good or product, yet it inherently offers a service to the patient in caring for their health. The term 'product' alone is used in the unit of analysis however, as previous research shows that the product name provides a focus around which to base the research for practitioner respondents and is also practical to bound empirically.

The literature review showed that innovative products are often studied from the point of view of the innovation process used to produce them (Tidd *et al.* 2005 pp10-77) or a product lifecycle (Utterback & Abernathy 1975). Existing literature often focuses on one part of the overall innovation process such as invention or development of the new product (Saren 1984 pp11-12), or implementation (Rogers 2003 pp96-98). This research studies the latter side of the overall innovation process or life cycle, as this takes account of the inter-organisational interaction involved in exploiting the product, the latter being a core part of the innovation definition. Implementation as defined by Tidd *et al.* (2005 pp88-97) and analyzed in the last chapter was selected as being most suitable for this research as the broadest term describing the latter parts of the innovation process, recognizing the inter-organisational context, where the supplier turns ideas into a product reality, exploitation occurs in launching it to the market and where the customer utilises it and finally sustaining the innovation with feedback.

Each innovative product case study occurs in a broader context. In this research the context for the unit of analysis is the network of supply relationships that are needed for producing innovative products according to Tidd *et al.* (2005 pp10-77), Axelsson (1987) and Von Hippel (1976 pp220-221). This research refers to supply relationships and networks (Harland 1996, Lamming 1996) as dyadic relationships or networks of relationships between customer and supplier interacting (Ford *et al.* 1986) to produce the innovative product. In practice the main customer and supplier organisations researched in the current study, the supplier or manufacturer of the innovative product and the public sector national health organisation in the UK buying it are composed of a number of sub-organisations and individuals.

4.3.3. Case Selection

In their discussion of sampling, or case selection, Miles and Huberman (1984 pp36-41) state that case selection parameters may be based on settings, actors, events or processes and are driven by the research question. However they describe how the researcher will have to consider most of these parameters due to the nature of qualitative research with no hard and fast boundaries for a sample. This research uses the innovative product unit of analysis as the sampling parameter.

A number of innovative products are selected as case studies in this research, but here too the boundaries of the case study are not fixed. Empirical research on supply in the healthcare sector has often focussed on product categories or supply of a particular type of product, though the definition of product categories is quite general. This research focuses on a particular named innovative product, yet recognises that this will require some gathering of general information on the product type or category. For example "blood glucose meter" is the (anonymised) name of one innovative product case in which empirical work was carried out with the supplier of that particular innovative product alone and a customer who considered implementing that particular innovative product. However broader data on the supply of the product can only be obtained in the form of data on supply of products in that category from some organisations and individuals who measure the performance of the product or consider implementing it, such as evaluation centres, purchasing policy makers and some buyers undertaking a tender process. Gathering this broader empirical data is both necessary where data does not exist for the particular innovative product alone, as well as providing what Miles and Huberman (*ibid.*) describe as important information that helps understand the peripheries of the case.

A wide variety of case choices were possible, given the large number of innovative products supplied to the NHS. The sector was chosen because of the inherently innovative nature of many of the products in a dynamic industry, as well as existing access for research, which helps facilitate progress and the ability to gain quality results. The large number of potential cases is demonstrated by the Centre of Evidence Based Purchasing having to develop a prioritisation process for evaluations of new products. Access to the chosen cases was largely gained by networking with stakeholders, including within each innovative product case to gain access to individuals in both supplier and customer organisations. Networking was carried out at a variety of research centre events, project team meetings and exploratory interviews. The networking aspect of gaining access is similar to judgemental or snowball sampling in a more quantitative study. These case selection methods represent an improvement in generalisability over the basic convenience selection or sampling often used in extant research in the area (for example Ritter & Gemunden 2004).

Yin (2003 p47) advocates that multiple case studies should be used to develop replication and analytical generalisability, rather than be seen as a sample size for statistical generalisability. He suggests that multiple case study research designs have greater generalisability, by adding cases to give the possibility of replicating findings from an initial case. This avoids the vulnerability of single case study research designs. There is also the possibility of drawing inter-case contrasts, as the innovative products selected are different in nature. Four innovative product case studies were chosen to allow sufficient scope for inter-case analysis, yet to ensure that a reasonable number of interviews could be accomplished for each, given resource constraints. The cases were chosen to share characteristics of being innovative products that are at the stage of being implemented by the customer and end user, to be from the same sector and to all involve a supply relationship between the supplier and NHS as a customer. However the cases were also chosen to contrast in terms of factors such as the cost of the innovative product, number of patients who would benefit and the impact of the product on the patient. The four innovative products cases selected were a multi-slice CT scanner, a blood glucose meter, an electrocardiogram (ECG) monitor and a standing frame for children. Table 20 gives a brief outline of the characteristics of the cases selected. The names of all products and suppliers have been made anonymous to ensure confidentiality of data gathered. While research on the cases was largely conducted concurrently, the CT scanner case was expedited and used as a pilot, with each step of the work carried out first on this case.

Practical implementation of case and stakeholder selection involved contacting organisations and individuals by email or telephone using a clear and persuasive statement of intent, having researched their background. Follow up emails and telephone calls were frequently required to encourage and gain access to the most appropriate individuals. To ensure valid cases and contacts were selected, stakeholder respondents were screened using the initial questions in the instrument, enquiring about the newness and exploitation to ensure the product was innovative for example.

	Multi-Slice CT Scanner (Case 1 & Pilot Case)	**Blood Glucose Meter** (Case 2)	**ECG Monitor** (Case 3)	**Standing Frame** (Case 4)
Innovative Product	A 64 slice CT scanner package of scanner, workstation and software for imaging patients	A portable device to test the level of blood glucose in diabetic patients	A halter recorder that stores and classifies heart arrhythmia	A frame to assist children aged 8-14 with a disability to attain or maintain standing posture
Product Category	Radiotherapy and imaging	Pathology	Cardiology	Assistive technology
Supply Relationship Context	Between the medical systems division of the manufacturer/supplier and the NHS, mainly hospital Trusts	Between the manufacturer/supplier and the NHS Primary Care Trusts, hospital Trusts	Between the supplier and the NHS, mainly Primary Care Trust GPs	Between the manufacturer/supplier and the NHS, mainly Primary Care Trust and hospital Trust paediatric physiotherapists

Table 20. Outline Characteristics of Cases Selected

4.3.4. Semi-Structured Interview Data Collection

Case study research has used a variety of data collection methods in practice, Yin (2003 pp83-108) for example referring to six potential sources of evidence. This research used stakeholder interviews as the central method, with some supplementary use of documentation and direct observations, as well as drawing network pictures.

Interviews were used as the main method as they have the potential to catch the qualitative, exploratory data dictated from the ‘what’ and ‘how’ nature of the research questions, being flexible in gathering data from the real individual actors involved with the innovative products studied (Yin *ibid.*). By contrast the widely used survey alternative would only have been appropriate for a conclusive, descriptive or explanatory study, as the closed questions typically involved do not allow for gathering of exploratory data of the type proposed by the research questions. Interviews may have varying degrees of structure in the questions asked of respondents. Semi-structured interviews (Bryman 2004 pp109-129) were used as they provide a balance between structure to satisfy the line of enquiry dictated by the research questions and allowing for exploration. Bryman (*ibid.*) describes key aspects that are desirable in semi-structured interviewing. These include using an interview guide with enough structure to aid cross-case comparisons, yet loose enough to promote flexibility in questioning.

An interview guide was developed, piloted, refined and updated throughout the course of the empirical work as part of the abductive process. It can be found in Appendix A and includes screening questions on the innovative product, organisations and supply relationship involved, as well as questions on performance measurement and performance management of the innovative product. Actual questions used descend from the research questions and are annotated in the guide shown in Appendix A according to a root in the existing literature upon which they were based. Table 21 highlights how questions in the interview guide were based upon the research questions and existing literature. Some questions explored the general concepts found in the literature and others aimed to gather longitudinal contextual data. Questions were designed according to Bryman (*ibid.*), for example not to be leading the respondent into a particular answer. They also contain prompts in case the interviewer sensed the need to delve deeper into some aspect of the responses, or if the respondent needed additional triggers. As such, the interviews were conducted in the style of a guided conversation.

Question in Interview Guide (found in Appendix A)	**Research Question**	**Example of Literature Basis**
A1-9, B1-4	All, screening questions	Oberg *et al.* (2007), Tidd *et al.* (2005) pp88-97, Harland *et al.* (2007)
C1	A,C	Neely *et al.* (2005), Farbey *et al.* (1993 pp75-94), Zheng Zhou (2006)
C2	A,C	Exploratory question
C3	A,C	Hendricks & Singhal (2003), Kaplan & Norton (1992), Ittner and Larcker (1998a), Skevington (1999),
C4	A,C	Kaplan & Norton (1992)
C5	A,C	Exploratory question
C6	A,C	Exploratory question
C7	A,C	Longitudinal question
C8	A,C	Exploratory question
D1	A,C	Radnor & McGuire (2004), Mintzberg & Lampel (1999), Halachmi (2005), Lebas (1995)
D2	A,C	(Halachmi 2005, Lebas 1995)
D3	A,C	Longitudinal question
D4	A,C	Exploratory question
E1	B,C	Lebas (1995)
E2	B,C	Exploratory question
E3	B,C	Exploratory question
E4	B,C	Griffin & Page (1996)
E5	B,C	Griffin & Page (1996)
E6	B,C	Griffin & Page (1996)
E7	B,C	Halachmi (2005), Bourne et al. (2005)
E8	B,C	Longitudinal question

Table 21. Interview Guide Questions and Their Basis in the Research Questions and Literature.

A variety of individuals from both customer and supplier organisations in the supply relationship were interviewed, with the network pictures (described below) helping to identify a spread of key actors across the cases to interview. Respondents were selected and screened with the initial interview questions on the basis of their involvement and knowledge of the subject matter. Job roles are given in Appendix B, though it should be noted that roles are given different titles, especially in the smaller suppliers. Forty-four semi-structured interviews were carried out and a listing of key details about respondents, length and place of the interview can be found in Appendix B. Between eight and eleven interviews were carried out per case, the difference depending upon the size of the organisations and number of actors involved in the case of the particular innovative product. A number of additional interviews had over-arching relevance to all four cases, particularly from strategic respondents from the customer. Some interview respondents became what Yin (*ibid.*) refers to as informants, where they suggested other individuals and organisations to contact in the form of a snowball sample. This has the benefit of being able to see if the account of a subsequent, recommended respondent corroborated the account of the first. Caution was exercised to ensure that no informant alone became dominant in directing the research. In practice there were sufficient respondents that this was not a risk.

The majority of interviews were carried out face to face, however many were also carried out by telephone, largely through the choice of busy respondents who were more prepared to find time for telephone interviews in their schedule. Average duration of the interviews was an hour, though this masks some extremes. Though they were very important to include, interviewing influential clinician buyers in their clinical setting often forced a shorter duration, for example as they were called away to conduct a scan on a trauma patient, whereas many office based buyers and lab based evaluators had more time to spare. Interviews were digitally recorded as '.wav' files on a digital sound recorder and transferred to a computer hard drive. Semi-structured interview sound files were saved on a computer hard drive with the file name annotated to include the respondent name and date. Files were indexed in a folder system according to the case. Target notes were also taken by the interviewer throughout the interview to back up the sound recordings and to note any additional observations. Some respondents were concerned about confidentiality of the interview data, in which case they were informed how it would be used, as well as that they and the innovative products concerned would be made anonymous. Given this, respondents were sometimes surprisingly open and controversial, with only two instances over the course of the empirical work where the recording had to be paused for a short period, though notes were still made.

As part of the semi-structured interviews, additional data was gathered from the respondents by involving them in drawing network pictures (Oberg *et al.* 2007, Iacobucci 1994 pp93-97) in which they were asked to draw their organisation, other organisations who were also involved with the same innovative product and the links between them. Organisations were represented as nodes and ties between them were differentiated according to the type of activity they represent. This enabled a network of actors and interaction to be built up for each case (Ford *et al.* 1986). As respondents found it challenging to draw the network from scratch, subsequent respondents were asked to improve upon, change or otherwise verify the previous network picture produced in the case of each innovative product. Sub networks and various levels can be identified when drawing the network (Iacobucci *ibid.*).

Documentary evidence was gathered where possible to substantiate the accounts of semi-structured interview respondents by triangulation. For example, tender guidelines for blood glucose meter national framework contracts were provided by the relevant NHS category specialist following an interview. Additional data observations formed part of what Lincoln & Guba (1985 pp279-281) refer to as informational residue. The main example in this research is the information garnered from evaluation project meetings attended at the Centre of Evidence-based Purchasing (CEP). The meetings were an opportunity to gather data on the context of the cases, which was very dynamic given changes in public sector purchasing and the NHS in particular. Notes made at the meetings were typed up into text files.

4.3.5. Time Horizons

The time horizon of the research is important as the research studies innovative products that are associated with a process of innovation or technological lifecycle, as discussed above. Ideally the research would have a longitudinal horizon to gather data on the temporal processes studied, however access and time implications prohibit this for PhD research. For example the CEP standing frame evaluation took several times the length of the main empirical stage of the empirical work in this research. Thus the case studies were cross-sectional, in common with much extant research in the area (eg Davis & Albright 2004, Bourne et al. 2005). However empirical investigation of the present enabled some gathering of data from the past, so some longitudinal context was gained. Semi-structured interviews were carried out over a period of about 6 months, allowing for piloting and access, though attendance of evaluation project meetings at CEP lasted longer.

As discussed previously, performance measurement and performance management of innovative products occurs at a variety of stages in their lifecycle. As the focus of this research is on the implementation of innovative products, cases were all selected from the range of potential products to be those that had been implemented by the customer and end user.

4.4. Data Analysis and Interpretation

This section outlines the techniques used to analyze and interpret the empirical data. The first section describes how pattern matching and explanation building are used, while subsequent sections describe how analysis occurred between and across cases.

4.4.1. Analytic Strategy and Technique

Yin (2003 pp109-140) describes reliance on theoretical propositions as a preferred analytical strategy, so analysis related the empirical data back to the research questions. To start with, a case description was generated for each of the four cases to gain some overall clarity and cohesion with all the data gathered. Pattern matching (Yin *ibid.*) is used to determine whether empirically identified processes of performance measurement and performance management and any identified influences they have on performance of the innovative product are matched with the conceptual model. The model may then be refined according to the patterns discovered in practice. In analysing patterns, comparisons were made between cases and any outliers investigated. As the research is largely exploratory, there was an aspect of explanation building (Yin *ibid.*) in terms of iterative development of understanding and the conceptual model. However the development of causal links is not appropriate for this research as described above and was not used when trying to build an explanation of the cases. Another of Yin's (*ibid.*) analytic techniques is cross-case synthesis, which is discussed below.

Yin (*ibid.*) advocates developing rival explanations to those in the conceptual model, to test if the empirical data supports the conceptual model or not. For example the analysis investigated processes that did not have an influence on performance, as well as those that did. Rival theories were also used in analysis of the empirical findings by investigating different rationales from existing literature as to how performance measurement and performance management could be differentiated.

4.4.2. Intra-case Analysis

HyperResearch 2.6 qualitative coding and theory building software was used to analyze the data. The software has similar functions to NVivo and other qualitative data analysis packages for social science research, but is different as it can use multi-media data including digital sound files, as opposed to only text files. Hesse-Biber *et al.* (1991) state that using HyperResearch as a qualitative analysis tool can aid the validity, reliability and generalisability of analysis. They describe how the tool allows coding of time specific segments of sound files and to sort codes by their incidence within and across cases. HyperResearch has been described as challenging the researcher intellectually and conceptually (Staller 2002).

Empirical data segments were coded by extensive listening to the sound files, the segments then being annotated with one or sometimes more of a number of codes. Codes were developed from the literature underlying the research questions and questions used in the semi-structured interview guide, to assist in pattern matching the data with the conceptual model. A list of the codes used at the end of the analysis can be found in Appendix C. The list mainly includes descriptive codes to answer the ‘what’ research questions about performance measurement and management processes, as well as a few interpretive codes developed during analysis, the latter being used to answer research questions on the influence of the processes. In addition a number of codes were added to the list during analysis as new themes, ideas and processes emerged from exploring the data. This iterative coding process from a start point of the conceptual model was recommended by Miles and Huberman (1984 pp54-65) and reflects the interpretivist philosophy of research and abductive approach discussed above. A further recommendation on coding the data as soon as it was gathered, before subsequent interviews, was also followed. HyperResearch enabled codes to be combined, split or segments to be re-coded or coded multiple times. As such, coding the data was an iterative process of sense making. Interview data was considered together with the documentary data and informational residue.

HyperResearch allows the raw interview data to be kept as time annotated sound files, which gives good data provenance and traceability from the coded segments identified for each case and used in the analysis. The use of digital recording and HyperResearch ensure the data is accurately preserved in the original format for any subsequent analysis or repetition of the analysis. While transcription and coding of paper transcripts or text documents is commonly used, transcribing puts another stage into the analysis process into which inaccuracies often occur (Poland 1995). Not only is the analysis further distanced from the raw data, the transcripts cannot convey the richness of expression and context to the words used that are captured on the digital sound files. For example, HyperResearch enabled the researcher to replay segments of the interview recording many times, listening for nuances in expression in the respondent.

The coded data for each semi-structured interview and respondent was entered into matrices to gain an overview of the cases by categorising the codes at a high level according to the research questions, with a succinct descriptive phrase. Role order matrices were used, though the categories used also meant that parts of the matrix were ordered by effects. Matrices are advocated in the literature as a summarising table display as they aid the researcher in drawing conclusions from the data (Miles & Huberman 1984 pp79-118). The matrices were used to compare and contrast the data from the different respondents within each case and then develop a summary description of the overall data for each case. Matrices of various lengths were produced and those which were ultimately used were found to contain the best amount of data in terms of a trade off between being concise to aid analysis, but also to contain sufficient detail. The final examples and rules used to construct them can be found in the Appendices.

Semi-structured interview data was described in the text along with contextual information from the network pictures and informational residue. Quotes from the semi-structured interview data were used to illustrate the data in the main body of the text, ensuring that they were representative of the mainstream of the data gathered and shown in the matrices. Network pictures were cleaned and tidied from their raw form using Microsoft PowerPoint 9.0 software, using coloured lines to illustrate the different flows identified in the empirical work.

4.4.3. Inter-case Analysis

Having analyzed the data within each case, meta-matrices (Miles & Huberman 1984 pp151-167) were used to analyze the data across the cases. The matrices were site ordered descriptive matrices and were used to show similarities and differences between cases. Identification of similarities in the matrices was aimed at providing generalisability of the individual case study findings (Yin 2003 p47). Cross case analysis also gives the opportunity to draw contrasts between the cases by looking for differences, identifying any particular contingencies in the nature of the innovative products or the context of the cases.

Development of the matrices was an iterative process of sense-making drawing on the various sources of data, trying to develop explanations of the nature and structure of performance measurement and performance management of the innovative products, given the open system and context. This strategy was in line with the chosen interpretivist stance and abductive approach. The following section outlines the steps taken to ensure the credibility of the research methodology, data analysis and interpretation. Figure 12 summarises the data analysis and interpretation process. More detailed descriptions of construction and interpretation of the matrices are given as they are presented in the findings chapters.

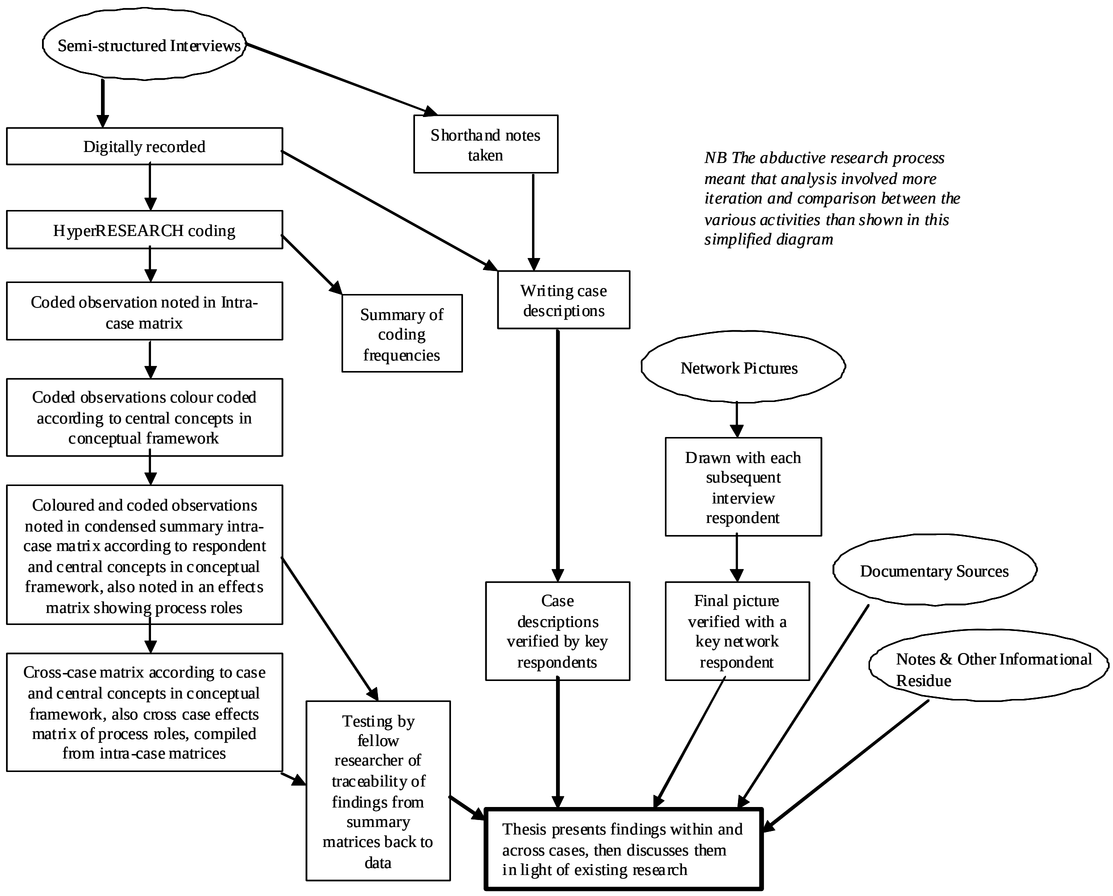

Figure 12. Summary of Data Analysis and Interpretation Process

4.5. Research Credibility

The credibility of the research design is established by four tests proposed by Yin (2003 pp33-39) for empirical social science research. Construct validity, internal validity, external validity and reliability are all outlined below in relation to this research. The limitations section returns to them at the end of the thesis.

4.5.1. Construct Validity

Construct validity is concerned with whether the research uses good or appropriate operational measures for the concepts studied empirically, a challenge in qualitative research where measures are developed and there is an element of the subjectivity of the researcher involved in analysis. To ensure construct validity, Yin (2003 pp33-39) states that the research must have specified specific phenomena to study and have selected measures of the phenomena that do actually reflect the phenomena. In this research, the concepts and questions used in the semi-structured interviews were based on concepts identified from existing research in the literature review. Yin (*ibid.*) recommends further tactics to ensure construct validity, which are used in this research. This includes using multiple sources of evidence, namely semi-structured interviews backed up with documentary, network pictures and informational residue sources. Another recommendation is to establish a clear chain of evidence which is achieved in this research by documenting procedures and particularly the strong link between findings and data enabled by the digital recordings and digital analysis software, HyperResearch. Yin (*ibid.*) also proposes having a respondent or other researcher review the data and findings. This occurred in this research through the feedback from PhD supervisors and other researchers on the broader research project of which the current PhD research is a part. A fellow researcher was asked to trace the provenance of randomly chosen findings in the main results matrix, back to the original data. The worksheet in Appendix D shows the results of this validation exercise. Further, the first draft of each case descriptions was sent to a respondent in the CEP Evaluation Centres who had an overview of each case, to validate them. A small number of amendments were made following the comments. Also, an NHS PASA respondent in a research related role had an overview of all cases and was asked to validate the case descriptions. An example of feedback can be found in Appendix E. Further, the broader project involved a number of feedback meetings with stakeholders in the public sector and their suppliers where this research was discussed and opinions gathered.

4.5.2. Internal Validity

Often associated with causality in quantitative, explanatory studies, internal validity has a different emphasis in qualitative, exploratory studies. It involves ensuring that the data and findings drawn from it within the study are coherent (Sykes 1991). To this end, this research also tested rival explanations (Yin 2003 pp109-140) especially the various ways of differentiating performance measurement and performance management from the literature, progressed an initial case as a pilot and iteratively improved the semi-structured survey instrument and analytical techniques in the coding software and matrices.

4.5.3. External Validity

External validity concerns whether findings of the current study are applicable to a broader context or reality than the one studied. As described in the selection of case study methodology, Yin (2003 pp1-18) states that analytical, not statistical generalisability is appropriate. To achieve this, a multiple case study design studying a variety of medical devices was used, so that there is a greater potential that findings replicated in all four cases could by replicated further outside this research. In addition to comparison across the four cases, the findings are discussed later in relation to the literature to see if similar findings have occurred in past, related research (Eisenhardt 1989).

4.5.4. Reliability

The final test involves showing that the processes used to carry out this research would achieve the same results if they were repeated, such as by another researcher. Yin (*ibid.*) describes the key defence against poor reliability as careful documentation of all procedures. This was aided in the current study by the use of a very structured software programme from which reports could be printed, so detailing the progress of the analysis. HyperResearch also required a very structured filing system on the computer hard drive for keeping the data and files were annotated with the date and new versions made after every major change. Reliability was also aided by the numerous discussions of the research with colleagues who were involved in the broader research project to which this PhD research contributed, as well as the tracing exercise above.

4.6. Summary

This chapter has investigated a range of possible research philosophies and methodologies, then determining the most appropriate for this research. An interpretivist research philosophy is adopted as it allows the development of explanations about the phenomena studied, yet recognises that the context of the research is complex and open rather than a simple, closed mechanistic system. An abductive research strategy was chosen in light of the philosophy and iterative nature of the research. These in turn determined that a multiple case study methodology is appropriate, enabling exploration and the opportunity to replicate explanations across cases studying complex contemporary phenomena in the real world, where the researcher had no control over the subject and the boundary with context was not clear.

The innovative product was chosen as a unit of analysis based upon existing literature and practical considerations. The sampling rationale, initial details of four cases and key semi-structured interview instrument as well as supplementary network mapping and gathering of documentary evidence were described. The analytic strategy and techniques were also discussed, involving pattern matching with the conceptual model, both within and across cases. Techniques stated included developing case descriptions, matrices and use of qualitative data coding and analysis software. This chapter finished by describing steps taken in the empirical work to try and ensure the credibility of the findings, which are described in the next two chapters.

CHAPTER FIVE: FINDINGS FROM FOUR CASE STUDIES

5.1. Introduction

This chapter reports findings of each of the four case studies in turn, following a brief contextual background to purchasing and supply of innovative products and medical device evaluation in the NHS. Each case is described in a linear analytic structure (Yin 2003 pp152-153), in accordance with the structure used in the interview guide and key concepts in the conceptual framework, which were in turn based upon the existing literature. The innovative product, the unit of analysis, is introduced for each case with a description of why each product is innovative. Some background to its implementation and management of purchasing and supply is also given, outlining the key organisations and processes involved. Performance measurement and performance management processes discovered in each case are outlined in the next section. Processes are differentiated here according to their definitions in the conceptualisation, focussing on performance management as being broader. Their influences on performance are then reported. The CT scanner case was progressed faster than the others as a pilot, and lessons from this are drawn in the summary of that case. The identities of organisations, products and individuals involved in the cases have been made anonymous for confidentiality. Following description of each case in this chapter, the next chapter focuses on inter-case descriptions and findings are then discussed in the context of the existing literature in the following discussion chapter.

5.2. Background to Purchasing and Supply and Medical Device Evaluation in the NHS

Each case features an innovative product purchased by the NHS as customer, from a private sector supplier organisation. The NHS as a customer buys a huge variety of products and services, such as capital equipment, food, fuel, syringes, drugs, property and staffing. Current total spend by the NHS on products and services excluding pay is in the region of £15 billion (HITF 2004 p17). Purchasing and supply management in the NHS involves a wide variety of organisations and individual actors who are part of the NHS as a whole. Purchasing is executed through buy groups or individual buyers on various levels, from local to national.

The NHS consists of 438 Trusts that have responsibility for local level care. Various types of Trust run services such as hospitals, General Practitioner (GP) surgeries and outpatient clinics. Individual clinicians or groups of multiple clinical and managerial individuals from the Trusts execute NHS purchasing on a local level. A large proportion (78.5% in 2004/5) of the NHS budget was allocated to PCTs, signifying their spending power (HITF 2004 p18).

Recent years have seen some NHS purchasing occurring on a regional level, where a number of Trusts get together to purchase goods and services, negotiating contracts on a collective basis. This has been formalised through setting up Collaborative Procurement Hubs (CPHs) (HITF 2004 pp15-20), to achieve savings and involve clinician input in purchasing decisions. There are CPHs at various stages of development for each regional NHS Strategic Health Authority (SHA), through which the Department of Health (DH) manages the NHS. On a national level, the NHS Purchasing and Supply Agency (NHS PASA), an Executive Agency of the DH, has played a key role. The organisation has developed purchasing advice, guidelines and national framework contracts for a large number of products and services, largely organised according to categories. NHS PASA is a strategic, rather than trading organisation and has been involved in developing and implementing purchasing and supply policy.

A number of changes in the structures and processes of NHS purchasing and supply have occurred in the recent past, many still being underway at the time of data gathering and thesis writing. Many of the national level purchasing and supply processes have been outsourced to the private sector from 1 October 2006, with the aim of achieving cost savings. DHL hold the contract for the category management processes, forming a new organisation called NHS Supply Chain, including many former PASA purchasing staff. A core of strategic supply management functions remains with NHS PASA. There is a long history of such changes, highlighting that purchasing and supply management in the NHS has always been dynamic. NHS buyers may buy through using the services of NHS Supply Chain, or alternatively individuals and Trusts may deal with suppliers independently.

As a customer and user, the NHS measures the performance of medical devices. Traditionally, this occurred in the Device Evaluation Service (DES), a part of the Medicines and Healthcare products Regulatory Agency (MHRA), an Executive Agency of the DH. DES outsourced evaluation work to a number of specialist evaluation centres based in hospitals and universities. From the 1 September 2005, the DES was transferred from the MHRA to NHS PASA to form the new Centre for Evidence Based Purchasing (CEP). Creation of this new Centre was recommended by the HITF, which advocated developing closer links between product evaluation and purchasing, providing evaluation outputs that reflect broad aspects of product value for a range of stakeholders across the NHS and industry (HITF 2004 pp1,35-36). CEP has been undergoing a change programme to achieve these aims, developing new evaluation report types in response to buyer's wishes and accepting a variety of proposals for evaluations from any source. Many of these new evaluations are one off projects, rather than ongoing evaluations of new generations of incremental product innovations in a particular category.

5.3. Multi-Slice CT Scanner

5.3.1. Introduction and Background to the Multi-Slice CT Scanner Case

Findings from the interviews in the multi-slice CT scanner case are summarised in Appendix F in an un-ordered meta-matrix, showing respondents in the rows and conceptual clusters in the columns, driven by the research questions, as recommended by Miles and Huberman (1984 pp79-80). It is a reduced version of the table compiled from the HyperResearch data, reduction having occurred according to a decision rule where cell entries in the original table were standardised to a more generic descriptor and taking the modal response where necessary (Miles & Huberman 1984 p104). This is in accordance with the pattern matching analytic strategy (Yin 2003 pp116-120), as priority is given to concepts described by more than one respondent in the case. Performance measurement processes sometimes had to be included in the table by the measures used, firstly for brevity, secondly because measurement procedures have been described as mapping and preserving the difference in a set of symbols and a collection of entities (Farbey *et al.* 1993 pp75-94), and finally because many respondents answered the questions about performance measurement processes by listing the measures that are used. Frequencies of the codes used in HyperResearch are shown in Appendix G.

Interview respondents in the CT scanner case, along with the others are shown in Table 22 and in more detail in Appendix B, including respondents whose interview data is relevant across all the cases, shown at the bottom of the table. Respondents are referred to by job role, organisation and type of role as a stakeholder. Roles are broadly described according to whether the respondent is from the NHS customer or supplier organisation sides of the supply relationship, with more detailed customer roles given according to the buying centre roles described by Webster and Wind (1972 pp77-80).

The Multi-Slice CT Scanner, referred to here as the 'CT scanner' is a hospital based medical device for taking internal images of patients for diagnosis and treatment planning.

The scanner consists of a patient couch, an array of x-ray beams, receptors and associated software to operate the scan, process and display image information. CT scanner technology now enables multiple 'slice' scanning of patients, in which successive x-rays are taken along the patient's body.

Respondent (Job Role)	Organization	Type of Stakeholder Role
Head of Medical Physics	Hospital Trust	Customer. Influencer (national level)
Head of Group	Evaluation Centre, Imaging Equipment	Customer. Influencer (national level)
Category Manager, Radiotherapy & Imaging	NHS PASA / NHS Supply Chain	Customer. Buyer, Influencer (national level)
Category Manager, Medical Maintenance	NHS PASA	Customer. Buyer, Influencer (national level)
Consultant Radiologist, Clinical Lead Radiology	Hospital Trust	Customer. User, Buyer, Decider (local level)
Consultant Gastrointestinal Radiologist	Hospital Trust	Customer. User, Buyer, Decider (local level)
Consultant Cross-sectional and Radionucleide Radiologist	Hospital Trust	Customer. User, Buyer, Decider (local level)
CT Superintendent Radiographer	Hospital Trust	Customer. User, Buyer, Decider (local level)
Radiology Business Manager	Hospital Trust	Customer. Buyer, Decider (local level)
Purchasing Manager	Hospital Trust 2	Customer. Buyer, Decider (local level)
Account Executive, Southern	Multi-Slice CT Scanner Supplier	Supplier (regional level)
Account Executive, South West & Wales	Multi-Slice CT Scanner Supplier	Supplier (regional level)
Respondents Interviewed for all Cases		
Policy and Innovation Director	NHS PASA	Customer. Influencer (national level)
Senior Collaborative Development Manager	NHS PASA	Customer. Influencer (national level)
Head of R&D	NHS PASA	Customer. Influencer (national level)
Senior Manager for Technology Introduction	NHS Institute for Innovation and Improvement	Customer. Influencer (national level)

Table 22. Interview Respondents in the Multi-Slice CT Scanner Case

The particular CT scanner studied in this case, referred to here as the 'CT scanner' is produced by one of four suppliers in the UK market. It has novel technological features representing incremental improvements on previous models as the latest version scans in 64 slices on two axes, as well as having increased scanning speed and software enhancements when compared with competitors. The improvements compared with previous models, which scan with fewer slices, enables cardiac scanning applications that were not previously possible because of the size and movement of the heart. The software enhancements and a gantry angulation feature to enable helical head scanning are unique to the scanner compared with other scanners. The workstation was also described as novel by clinicians, such as a new feature for locating the area of the scan on the patient's body. The supplier sells the scanner for commercial gain, while the NHS as a customer benefits from opportunities given by the scanner to provide improved healthcare. In summary the CT scanner is innovative as it has novel features and is exploited for commercial and healthcare benefits.

The network picture in Figure 13 shows the main actors and flows between them (Oberg *et al.* 2007, Iacobucci 1994) in the case, as depicted by the interview respondents. The organisations of the interview respondents are highlighted in yellow, to provide a link with Table 22 above. It was compiled by each subsequent respondent developing the picture through improving, altering and verifying it. Detailed notes on the key to the picture are in Appendix H. Implementation of the CT scanner has involved interaction between various actors from the supplier and the NHS as customer on different levels. Purchasing and supply of the CT scanner currently only occurs at the local level by NHS Hospital Trusts, though previously there were national level bulk purchases using funding from the National Cancer Plan. In the empirical research the Hospital Trust that the majority of the clinicians interviewed came from, was in the process of preparing to purchase two CT scanners and formed a purchasing team, consisting of actors including Trust finance and purchasing managers, staff from the Medical Physics Department and clinicians in the Radiology Department. Currently collaborative procurement hubs and NHS Supply Chain are taking an interest in CT scanner purchasing, but have not yet made any purchase decisions. Respondents discussed other national level public sector actors that have a role in the purchase and evaluation of CT scanners, such as the NHS III, MHRA and NICE.

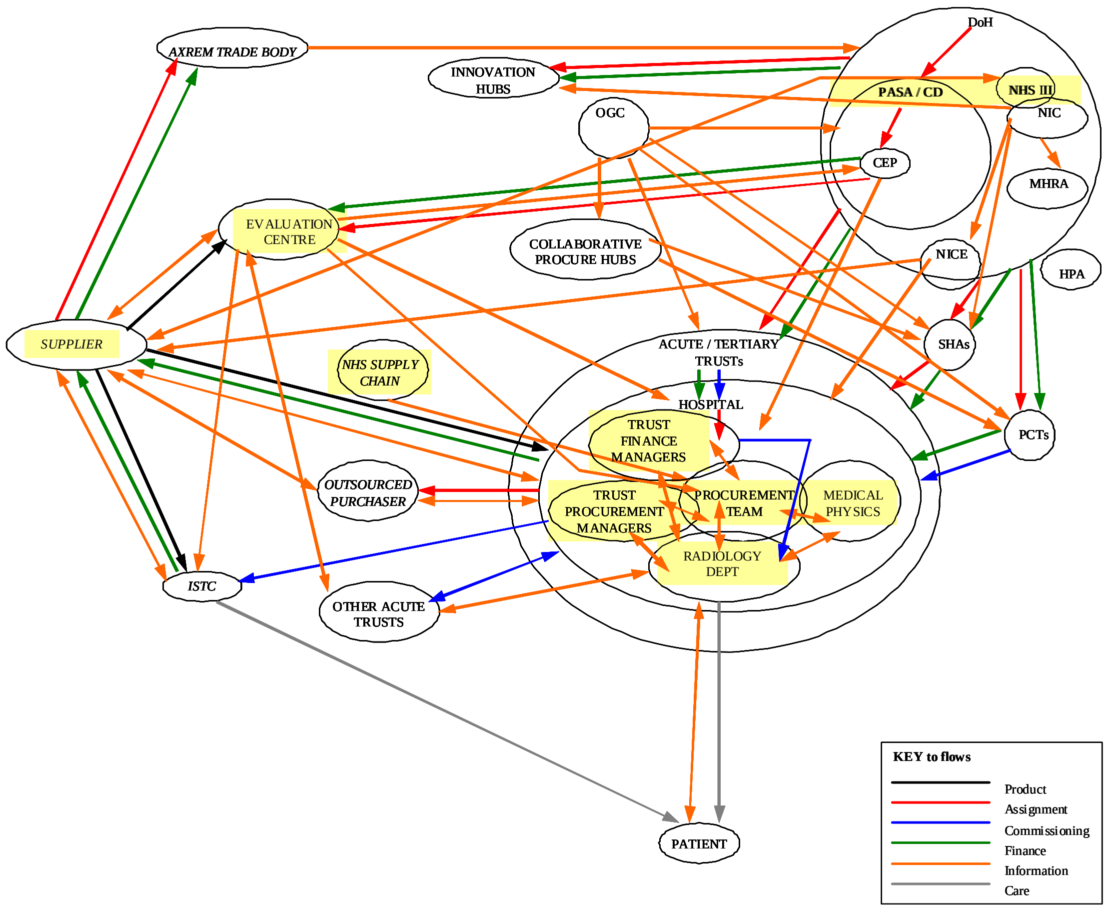

Figure 13. Network Picture for the Multi-Slice CT Scanner Case

5.3.2. Performance Measurement and Performance Management

This section reports the performance measurement and performance management processes described by the interview respondents, in the following two sub-sections. Initially performance measurement processes are discussed, focussing on those processes that meet the basic definitions of performance measurement outlined previously in the thesis (Neely *et al.* 2005, Farbey *et al.* 1993 pp75-94) and conceptualisation. Then broader (Halachmi 2005, Globerson 1985, Lebas 1995) or follow up (Globerson 1985, Ellram 1995) processes are described in the performance management sub-section. The discussion chapter analyzes differentiating performance measurement and performance management processes on the basis of their influence or otherwise on performance (Bourne *et al.* 2005, Halachmi 2005) which are reported later in this chapter. Figure 14 at the end of this case description shows the conceptual framework illustrated with the findings of the CT scanner case.

Performance Measurement Processes

A variety of performance measurement processes, focussing on a range of performance measures were discussed by interview respondents. These include an Evaluation Centre technical evaluation, assessments of the performance of the scanner by Trust buyers as part of the tender process, national level budgeting in the NHS and gathering user opinions about the scanner by the supplier. The findings are described here in terms of the key concepts discovered and explored with respondents, assessed through the analytical process of coding and constructing matrices.

Comprehensive technical evaluations of CT scanners are carried out by the evaluation centre on behalf of CEP, usually involving two or three medical physicist staff visiting a scanner and running a series of tests. Although each evaluation is a one off, successive generations of scanners with incremental innovations have been evaluated by the Evaluation Centre, giving an ongoing aspect to evaluation. The technical measures used focus on the clarity of image versus the radiation dose, a crucial concern in using the scanner. Radiation dosimeters and ionisation chambers are used for measuring radiation dose. New features of the scanner are also described and evaluated. Phantom test objects are used to test technical parameters of over 10,000 scanner images taken during the evaluation. Financial measures are not used and quality of life measures are not involved, partly as the CT scanner is used in the diagnosis and treatment of so many different diseases that it is difficult to generalise about its benefits financially or for quality of life. The Evaluation Centre communicates frequently with the supplier during evaluations, requesting information, involving supplier representatives in conducting the evaluation and feeding back results.

Performance measurement was also found to be part of the process of purchasing new CT scanners, by the purchasing team in the Hospital Trust. Data is gathered on the technical and financial performance of the CT scanner and competing products from the various suppliers in the market, by clinicians and managers as part of the tender process. Interactions also included clinicians visiting examples of the scanners at other hospital sites to see a demonstration, talk to users or try using it themselves. Clinicians use these processes to learn about how the scanner might perform for their particular clinical needs in the Trust, while supplier representatives take the opportunity to learn what the Trust is looking for in a particular purchase:

"…the invitation to tender would come out, I would find someone to contact and go and have a chat and say, look, what exactly are you looking for…you go and see them, what are you looking for, what type of work…what would they like to see, what have they got at

the moment, and then from that I would assess with the Applications Manager the best site to take them to, to view the system" (Account Executive South West & Wales, Supplier).

Social exchange occurs on an individual level in many relationships, for example a radiologist on the Trust purchasing team described calling former colleagues for their own experiences with different models of CT scanners being considered in the tender:

"…what I did at the beginning was I picked up the phone and phoned my mates in Bournemouth and wherever else who've used [a CT scanner from the Supplier] *and asked them how's it been? And these are people I know, who I trust, I've trained with them…"* (Consultant Cross-sectional and Radionucleide Radiologist).

Most of this data gathering involved the clinician making subjective assessments of how the CT scanner could be used for the particular interests of the Trust, though the Procurement Manager in Hospital Trust 2 described how clinicians are asked to score aspects of the scanner when making this assessment. In the first Trust, radiologists were particularly interested in cardiology and virtual colonoscopy software packages, given the Trust's amount of work in these areas.

Technical performance of the scanner is also measured, using similar measures of image quality and radiation dose as the evaluation centre, by the supplier. The focus is also on measuring technical aspects such as data acquisition speed and data processing speed. The CT scanner went through alpha and beta testing in hospitals prior to market introduction, after which feedback on the CT scanner from the point of view of the user is continuously gathered by supplier sales and applications staff through their contact with Trust staff and tenders in the field.

NHS PASA Category Managers have also been involved in performance measurement of CT scanners, as part of their buying role. Key measures used on national contracts in the past are technical and operational focussed upon reliability and maintenance costs, in particular the up time and down time of the CT scanner, expressed as a percentage figure. Maintenance has a significant role in this up time down time balance and a performance measurement survey has been sent out to Trust staff to determine their perception as customers of supplier maintenance performance. The cost of maintenance contracts are also measured, though the impact is on revenue budgets, rather than capital budgets as with the purchase of the CT scanner.

Performance Management Processes

A variety of performance management processes were described by respondents in the case, mainly involving using the data from the performance measurement processes already described. The findings are described in terms of the key themes identified empirically and reported in the existing literature, including data analysis and dissemination, making purchasing decisions and improving the design of the product.

After measuring performance in the technical evaluation, the large number of images taken in the technical evaluation are investigated by Evaluation Centre actors in a semi-automated software analysis and compiling data into tables. For example, an image ‘Q’ figure is calculated, based upon a variety of underlying technical image parameters that were measured. Reports of data from performance measurement of the scanner are issued and disseminated by the Evaluation Centre to CEP as well as purchasers and clinicians within the NHS. Reports have focussed on both the individual CT scanner and in comparison with peer scanners. Also, equivalent data is requested from the supplier and has been compared with that obtained by the Evaluation Centre in a data comparison report. Technical evaluation information is also disseminated through a website including an online database tool, mailing lists and detailed training and development courses offered by the evaluation centre.

Another process that followed up performance measurement is the supplier tailoring the scanner package in the tender return to the needs of users. The supplier responds to Trust tender requests by a formal tender return, in which a price is given for a scanner package put together for the particular Trust’s needs. A Supplier Account Executive gave the example of offering three workstations in a package with two 64 slice CT scanners for optimal workflow. A particular package may also include additional software packages for cardiac work or virtual colonoscopy for example. The supplier offers a training process to all clinical staff at the Hospital using the product and holds an annual meeting between their applications support staff and Trust staff, relaying the latest product information.

In addition to tailoring the scanner package to particular customers, the supplier is also continuously improving the design of the scanner. Problems and issues with the product are picked up by supplier staff during the tender process as well as visits before and after, these issues then being fed back to the research and development team in the Japanese factory which operates on principles of continuous improvement, efficiency, waste free production and satisfaction of the end customer. At the factory, it seems that feedback is used to improve the design of the product, normally through re-engineering the software packages, with the improved versions then being released onto the market. Target specifications for the scanner and associated software and workstations are set, then actors set out to exceed these in product development.

Respondents also described performance management processes that use information gathered in performance measurement for purchasing purposes. The Hospital Trust purchasing team described performance management processes in the tender process, especially decision making by the purchasing team regarding which of the tenders received from the various suppliers to choose. Processes include subjective discussion of the attributes of the various CT scanners in committee, comparing performance measurement against the tender specification and then making a decision on the basis of maximum utility gained for the fixed budget available. Utility varies according to different members of the purchasing team, so a process of compromising on attributes of the scanner package occurs in the committee. A scoring and weighting system is used in the committee to analyze performance measurement data provided by the suppliers in their tender returns. The committee's decision is sent for approval by the finance department, suppliers are debriefed as to their success or failure in the tender process and an acceptance testing procedure occurs once the new CT scanner has been installed. While there are efforts to procure medical equipment maintenance at the national level, many Trusts still handle their own maintenance budgets and contracts. The Category Manager for Radiotherapy and Imaging was previously involved in purchasing CT scanners on a national level and has now been transferred to NHS Supply Chain, though discussed a lack of clarity as to their current role.

While issuing purchasing advice, guidelines (NHS PASA Procurement Guidance) and templates (NHS PASA Workbook) from NHS category staff are broader processes than measuring performance during purchasing, respondents at the local levels did not refer to them in the discussion of performance management beyond including them on the network picture. Indeed a supplier respondent had not heard from NHS PASA or Supply Chain since the end of the National Cancer Plan purchases. Meanwhile National Consortia Contracts for Medical Equipment Maintenance (NHS PASA Procurement Guidance pp12-14) with each key medical equipment supplier, including the supplier of the CT scanner in the current case are currently being developed by the Category Manager for Medical Maintenance. Respondents showed NHS PASA and NHS III as having a role in developing and implementing policy with implications for purchasing of innovative products such as the multi-slice CT scanner.

5.3.3. Influence on Performance

This section reports on data from the respondents that describes or suggests the influence of performance measurement and performance management processes, described above, on performance of the CT scanner. The findings are described in terms of the key themes that arose through the analysis process of coding and constructing matrices and are linked to key processes described in the previous two sections.

Table 23 summarises the influences found in the case, based upon the effects matrix (Miles & Huberman 1984 pp114-118) compiled from respondent data, which can be found in Appendix I. It summarises the ways in which respondents have described an influence of the above processes in performance of the CT scanner, stating the influence and the processes. In some instances, the processes were not made apparent by the respondent, however Miles and Huberman (1984 p114) point out that there must always be an implicit predecessor and this is also shown in the table. The cell entries are brief phrases highlighting influences that were coded in the case study and shown in the data in the original matrix of findings from respondents in the CT scanner case. Only those influences that were seen in a pattern across more than one respondent in the code occurrences by respondent in the case are included. As recommended, researcher's explanations are given and an asterisk used to denote an influence inferred by the researcher, rather than one specifically described by the respondent. Where the processes were described as having a beneficial influence (+), non-beneficial influence (-), both (+/-) depending on the actor concerned, or no influence (none) this is shown in the first column of the table. The influences are also annotated as to their influence on financial (F), technical (T) or customer (C) performance (Griffin & Page 1996). In a similar example of a matrix, Miles and Huberman (1984 p116) point out that such a matrix will include intended outcomes or influences, or those that the respondent states will occur.

The main influence of performance measurement and performance management processes that were observed in the case, was in whether the CT scanner or another competing CT scanner was purchased. All but two respondents in the case described this influence on over fifty instances in the text, referring to the purchasing decision makers using information from performance measurement to make a purchasing decision, with the result that the CT scanner is purchased or not. If the product was purchased, the processes had a beneficial influence on performance for the supplier who made sales of the product and therefore money if a profit margin was involved, and for the customer who gained the benefits of the product for use in healthcare. If the product is not bought on the other hand, the influence is non-beneficial for the supplier that loses sales to a competitor, though the customer gains the benefit of using the competing product in healthcare.

Influence	Type	Researcher Explanation
Product is purchased or not	+/- F/C	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare.
The best product for the needs of the user is purchased	+ C	The tender process of assessing performance of the various scanners available and decision-making gives the Trust the best CT scanner for their particular needs.
Product can be purchased or not for short-term, cost based rather than broader reasons	- C	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.
Information not used in the purchasing decision	None	Information from performance measurement and management processes is not used in the purchasing decision. The product may be bought for all sorts of reasons other than on the basis of performance measurement information. Technical evaluation reports are too late, clinicians know already or do not have time to use info.
Product design improved	+ T	The design of the CT scanner and associated package is permanently improved, for example through new software releases, an improved service package.
Feedback to the supplier is not used	None	Feedback on performance measurement information given to the supplier is not used. Customer is small.
Used in acceptance testing	+ T	Performance measurement outputs such as technical evaluation reports are used to ensure a scanner meets the promised specification on installation, before full payment is made to the supplier.
Useful for repairs	+ T	Customer’s own performance data makes the case to the supplier to come and make repairs to the scanner.
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	+ T	Performance measurement and management processes mean that the supplier know and ensure that the product must meet a certain standard.
Supplier shows concern over performance measurement	* +/- F	Suppliers show concern that performance measurement data will affect their competitive position or sales.

Table 23. Summary of Influences Identified in the CT Scanner Case

(**KEY:** ‘+’ is a beneficial influence, ‘-‘ is a non-beneficial influence. ‘F’ is an influence on Financial performance, ‘T’ is an influence on Technical performance and ‘C’ is an influence on Customer performance (After Griffin & Page 1996). ‘None’ means there is no influence on performance. ‘*’ denotes an influence inferred by researcher rather than specifically described by respondent).

The variety of performance measurement processes involved in whether the CT scanner was purchased or not vary, including the members of the Trust buying team assessing the performance of the CT scanner and the technical evaluation carried out by the Evaluation Centre. Performance management processes centre around the purchasing tender process, involving scoring and weighting, comparing supplier's tender returns against the desired specification and making a decision in committee. The decision involves some amount of scoring and weighting, though also subjective discussion amongst committee members and compromise between them: *"…it will come down really to local negotiations amongst ourselves of what we feel is the best, it may be that there, there will be compromises…"* (Consultant Radiologist, Clinical Lead Radiology, Hospital Trust). There were some differences between the Trusts in use of the scoring system however, in the second Trust the decision was made on the basis of the scoring system, whereas in the first Trust it was described how: *"…we have actually got the scoring thing…we will do that, but I would like that to be done on the basis of our own assessment"* (Consultant Radiologist, Clinical Lead Radiology). Once the decision has been made to purchase a CT scanner, the Evaluation Centre reports have been used in acceptance testing of the scanner, to ensure it performs as expected and promised in the tender return.

Having made a decision to purchase the CT scanner or a rival product, the Trust concerned will have selected a product that will perform for them in a particular way: *"We've got to work on this machine, all of us, for many years and going to have to pin our service quality on our choice and our service delivery on that choice and our names are on the bottom line, our service, the quality of the service we provide is going to be judged partly on our choices…"* (Consultant Radiologist, Clinical Lead Radiology, Hospital Trust). Since finishing the main data gathering of the case, the purchasing decision was made in favour of a competitor CT scanner, rejecting the CT scanner tender from the supplier studied in the case. The supplier of the CT scanner chosen instead is the supplier of the existing CT scanners at the hospital and according to the Evaluation Centre, the purchasing team were keen to continue using the existing supplier for the known quantity of their service support and engineers. Respondents discussed the influence of performance measurement and performance management processes not only in purchasing the CT scanner or not, but more specifically in purchasing a CT scanner package that is tailored to be most appropriate for the particular needs of the Trust: *"I think it* [performance measurement] *helps us buy the piece of equipment that's most appropriate for us at that time in so far as what our needs are and what we hope to do in the next few years."* (Consultant Cross-sectional and Radionuclide Radiologist).

Some respondents described how information from performance measurement and performance management processes did not have an influence. While some had stated that technical evaluation reports had been used in making the purchasing decision, others such as a Purchasing Manager in a Trust that had recently completed a CT scanner purchase stated that the reports had not been any use because they were published too late and contained information that clinicians in the sector already knew: *"No* [evaluation reports are not used], *because again they came out sort of slightly during and after."* and: *"…it's a fairly incestuous market…most of the radiologists, and say, the CT stroke MRI techies and clinical people, are fully aware of what's going on in the market place, because there aren't that many machines and that many companies, it's not as if you've got to read hundreds of reports and look at hundreds of pieces of equipment or loads of technical literature"* (Purchasing Manager, Hospital Trust 2). When validating these case descriptions, a PASA respondent stated that these comments may relate to old style DES or CEP reports and that those produced more recently have addressed these concerns to be more user friendly. However PASA have an interest in seeing their reports as useful and the analysis here relates to the cross-sectional data gathered before many new CEP products had been fully introduced.

In addition to those processes that did not have an influence, respondents described how purchasing decisions were often driven largely by cost, suggesting that measurement of broader aspects of performance did not have an influence on the decision: *"The problem is the price is a fairly big issue for us, we'll have to take it into account."* (Radiology Business Manager, Hospital Trust). This was echoed by national level respondents, commenting how measurement and management of broader aspects of performance than financial aspects was not considered and that users of evaluation information must be able to make sense of it: *"CT can do all the value stuff that you like, but unless you've got an organisation in the NHS that can make sense of that and it remains close to what their value framework is, there's just no point in doing it"* (Policy & Innovation Director, NHS PASA).

Other influences described by respondents are also concerned with whether the CT scanner was purchased or not, especially where suppliers were described as paying close attention to information from performance measurement for competitive reasons. Suppliers were keen that the technical evaluation report for example, showed their CT scanner in the best light to potential buyers, suggesting that suppliers think the information is used by customers and affects their sales: *"…if they* [supplier] *don't like the data and they don't come top of the list in our image quality performance index, we get a lot of aggro"*. (Head of Group, Evaluation Centre). Indeed suppliers have pointed out performance issues with competitor products as shown in the Evaluation Centre data and used evaluation data in their own marketing materials. This sheds new light on the above conflicting findings of whether technical evaluation data is used. Perhaps unsurprisingly Evaluation Centre respondents suggested that reports and the website were appreciated by respondents, useful in making the decision and subsequent acceptance testing for example. However the Head of Medical Physics suggested that many uses of the information would be implicit and not through CEP.

Another influence discussed by many customer and supplier respondents was that of information from performance measurement being used by the supplier in a process of technological innovation, giving improvements in the design of the CT scanner. This occurred on the basis of information from the Evaluation Centre technical evaluation fed back to the supplier as well as information gathered by the supplier themselves throughout the tender and applications support processes. Following feedback from customers, the supplier has achieved a lower radiation dose for the image quality compared to their previous CT scanners, as they have traditionally been known as a ‘high dose’ brand. Reinforcing this finding, the technical evaluation reported that all four 64-slice CT scanners currently on the market have a similar technical performance in terms of the fundamental image quality and radiation parameters discussed by the Evaluation Centre (Lewis *et al.* 2006 pp3-15).

From the point of view of the Supplier, an Account Executive also stated that their feedback from the customer to the research and development team in their Japanese factory improved the technical performance of the CT Scanner: *“Customers will feed back problems, wishes, suggestions for improvement, that gets fed back to the factory and they work on the software and hardware”* (Account Executive Southern, Supplier). The Account Executive described how most changes are made through releases of new improved software, though respondents also described improvements to hardware and the service package. The latter involved the supplier on-shoring a previously offshored service centre, in response to national level feedback on customer performance of the service package by NHS PASA. However, feedback from customer users to the supplier was not always used, respondents stating that the UK NHS is a very small customer for the supplier internationally, so much feedback is required before technical changes are made to the product.

In addition to an influence in acceptance testing described above, respondents said that the knowledge that the CT scanner will be subject to various evaluations or assessment by the customer encourages the supplier to ensure the CT scanner performs as claimed: *"…evaluate what the scanner does and what the supplier says it does and make sure it does do what the supplier says it does, and I think* [the Evaluation Centre] *has improved that from the early stages of their assessing the scanners, I think that has improved it, I think feedback from Trusts will also again improve the scanners and having that done in a more structured way will improve the reliability of their equipment."* (Category Manager, Radiotherapy & Imaging, NHS PASA / Supply Chain). There is also an influence of the technical evaluation in ensuring the performance of the CT scanner is as expected during the life of the scanner, the customer using information such as that from the technical evaluation to justify any problems with the scanner to busy supplier engineers. This aids getting the scanner repaired, according to the Head of Group at the Evaluation Centre and the Radiology Business Manager.

Findings of the CT scanner case are illustrated in Figure 14 and the next section draws together a summary for the CT scanner case.

5.3.4. Summary from the Multi-Slice CT Scanner Case

The CT scanner case describes an innovative product that is implemented in the context of a complex network of supply relationships. Hardware and software features on the scanner studied make it novel in the market.

The case highlights that a variety of performance measurement and performance management processes occur during implementation of the scanner in NHS Hospital Trusts, including the purchasing, or tender, process. Actors variously measure technical, customer and financial aspects of performance and the case showed that as well as formal, quantitative processes, many are subjective and involve social and informational exchange.

In many examples performance measurement is followed up by varied performance management processes, such as analysis and dissemination of performance measurement information to other actors, making a decision about which CT scanner to purchase and making changes to the product package or scanner design.

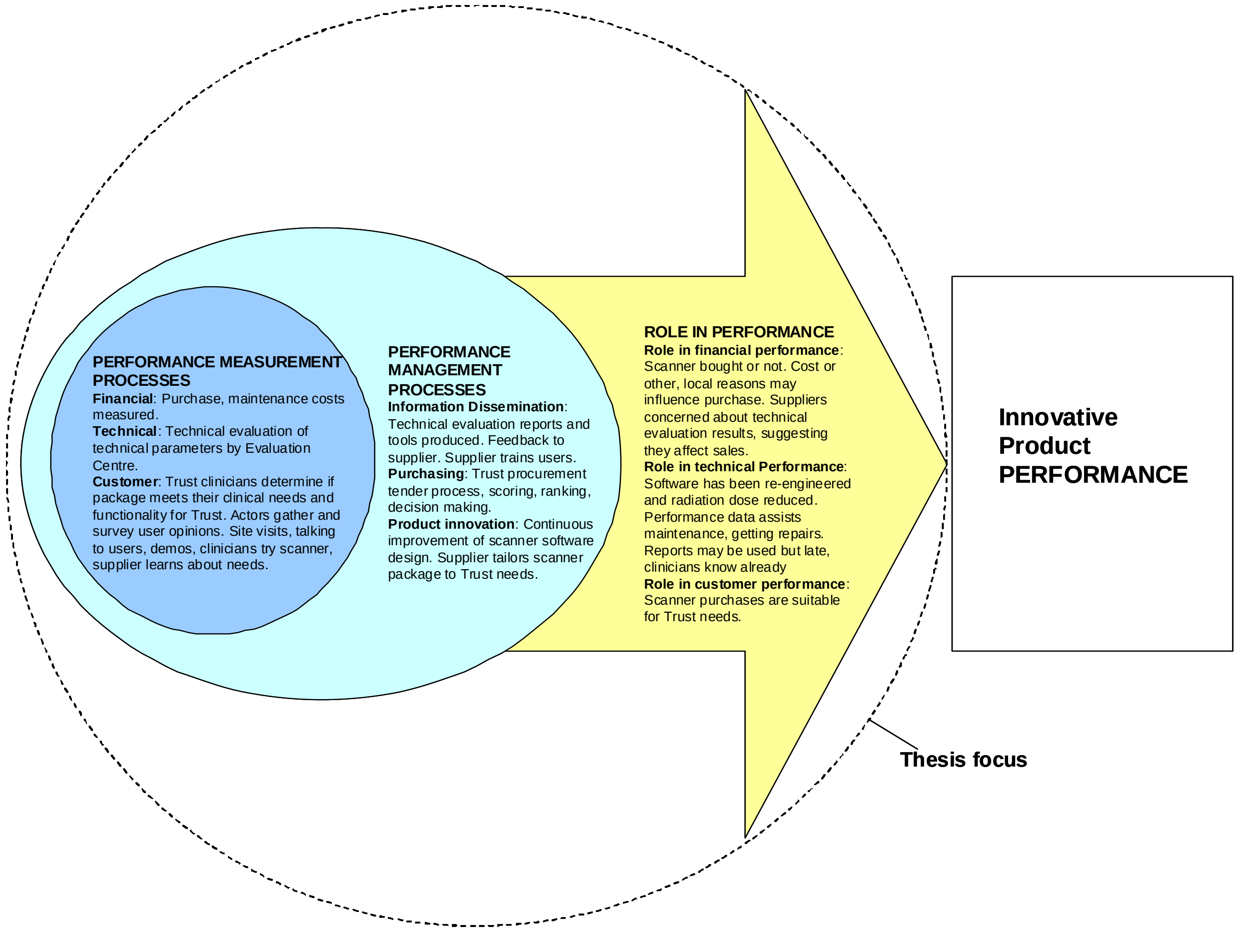

Figure 14. Conceptual Framework Illustrated with Findings of the CT Scanner Case

Respondents also discussed the influences of some of the processes they had described. Some processes had beneficial and non-beneficial influences on performance and some had no influence at all. Often two or more processes were described or implied as having an influence together, for example the supplier made technical design changes to their product in response to user feedback. In contrast to the performance measurement processes, more of the performance management processes were described as having an influence on performance, such as making a purchasing decision and improvement of the product design. In particular, the data suggests that where processes had beneficial or non-beneficial influences rather than no influence, the performance management processes involved proactive, decision-making use of performance measurement information by buying or innovating actors. A non-beneficial influence described by respondents involved partial use of performance measurement information, with a focus on cost performance only. Alternatively where no influence occurred, performance management processes involved less proactive use of performance measurement information, such as limited use of performance measurement information due to issues of mutual understanding and timing.

Lessons from the Pilot Case

This case was progressed faster than the other cases, as a pilot. The pilot brought up a few conceptual and methodological issues that were addressed as this and the other cases were taken forward.

Key conceptual issues highlighted by the case are the complexity of the network of supply relationships and particularly the NHS as a customer organisation, with actors on many levels. The dynamism of purchasing and supply management in the NHS is evident, with national level purchasing having a much reduced role since the end of National Cancer Plan funding. Roles of national level actors have changed with the advent of NHS Supply Chain and were not totally clear from the respondents. In response, the interview guide was changed to include more questions to gather contextual information on the background to the case in the network of supply relationships, which may be of use in analysing complex, dynamic cases.

Methodological issues were also raised, for example the accounts of respondents differ in places, as to the use made of technical evaluation reports. In response to this, documentary evidence was gathered to triangulate accounts where possible, in this and subsequent cases. Respondents were also encouraged to give examples. The differing accounts may also be due to the variations in practice at a local level, reinforcing the need for screening questions.

The case also highlights that some actors identified by respondents in the network pictures referred to the CT scanner studied as a focus in this case, while others referred to, for example, evaluating CT scanners in general, or the product category. Although this is a lesson in itself, the interviewer became increasingly aware of the need to clarify when comments made by a respondent referred to, say, evaluation of CT scanners in general, or the CT scanner studied here in particular.

The data reported above is described again from a cross case perspective in the next chapter, then discussed in detail in the context of existing knowledge in the subsequent chapter. First however, the other cases are discussed in the remainder of the current chapter.

5.4. Blood Glucose Meter

5.4.1. Introduction and Background to the Blood Glucose Meter Case

A summary of interview respondents in the blood glucose meter case are shown in Table 24 and in more detail in Appendix B, their roles being described further in the following sections. In Appendices J and K are a matrix of findings from the respondents interviewed in the blood glucose meter case as in the previous case, and further detail showing frequencies of the codes used in HyperResearch.

The blood glucose meter is a medical device that a patient user in the home can use to determine their blood glucose level. The product consists of an electronic meter that chemically analyzes a capillary blood sample and displays the level of blood glucose, consumable product specific test strips that use an enzyme required for the chemical analysis and an associated service package.

The blood glucose meter studied here is from one of six to eight main suppliers in the UK market (Device Evaluation Service 2005 pp1-3). It can be considered innovative as it is being commercially exploited by the supplier for financial gain and contains new to the market and firm features, which are exploited for purposes of improving healthcare. The meter comes with a novel service package including help lines staffed by diabetic specialist nurses (DSNs) who can interpret test results uploaded by the patient to the internet, lifestyle advice, training courses and even access to recipes for diabetics, all provided by the supplier. For example, software that can be downloaded for use with the blood glucose meter enables users to tabulate and graph results, helping them to manage their disease. In addition to these novel features of the specific product, the meter and other contemporary meters on the market feature incremental improvements, being physically smaller, requiring a smaller blood sample (1μL) and producing test results faster than earlier products.

Respondent (Job Role)	Organization	Type of Stakeholder Role
Head & Biochemistry Director	Evaluation Centre, Pathology Devices	Customer. Influencer (national level)
Technical Evaluation Leader	Evaluation Centre, Pathology Devices	Customer. Influencer (national level)
Category Manager, Pathology	NHS Supply Chain	Customer. Buyer, Influencer (national level)
Category Specialist, Pathology	NHS Supply Chain	Customer. Buyer, Influencer (national level)
Pharmaceutical Services Manager	NHS Prescription Pricing Division	Customer. Decider, Gatekeeper (national level)
Manager, Point of Care Testing Team	Hospital NHS Foundation Trust	Customer. Influencer, Buyer, Decider (local level)
Diabetic Specialist Nurse	Hospital NHS Foundation Trust	Customer. User, Decider (local level)
Diabetic Specialist Nurse	Primary Care Trust	Customer. User, Decider (local level)
Service Development Manager	Pharmacy Plc	Customer. Buyer, Decider (national level)
Director Care and Policy	Diabetes UK	Patient Body. (national level)
Senior Marketing Manager	Blood Glucose Meter Supplier	Supplier (national level)
Director General	British In-Vitro Diagnostics Association	Supplier Industry Body (national level)
Respondents Interviewed for all Cases		
Policy and Innovation Director	NHS PASA	Customer. Influencer (national level)
Senior Collaborative Development Manager	NHS PASA	Customer. Influencer (national level)
Head of R&D	NHS PASA	Customer. Influencer (national level)
Senior Manager for Technology Introduction	NHS Institute for Innovation and Improvement	Customer. Influencer (national level)

Table 24. Interview Respondents in the Blood Glucose Meter Case

Figure 15 shows the network picture for the blood glucose meter case, again with the organisations of the interview respondents are highlighted in yellow, to provide a link with Table 24 above. Meters are supplied to both the home and hospital markets. The meter studied here is used predominantly in the home market by patients themselves, though this also involves interacting with clinicians in outpatient clinic and hospital settings.

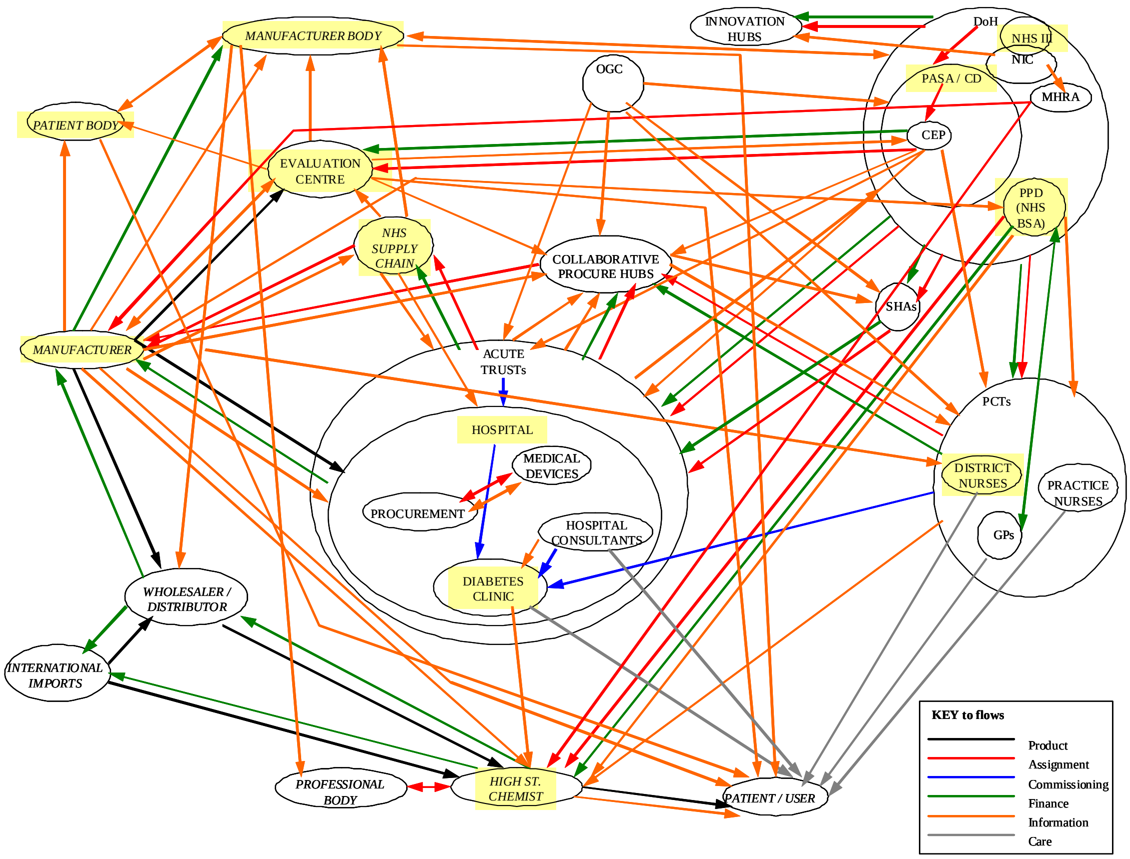

Figure 15. Network Picture for the Blood Glucose Meter Case

In Primary Care Trusts (PCTs), District Nurses, Practice Nurses and General Practitioners (GPs) are all involved in diabetes care for the patient and commission care from diabetes clinics in Acute or Hospital Trusts where Consultants and Diabetic Specialist Nurses (DSNs) also care for the patient. The blood glucose meter is given to the NHS clinicians and patient user free by representatives from the supplier, who then charge for the consumable strips, though in some instances the patient will buy the meter directly from the high street pharmacy. Strip purchase and supply is shown in Figure 16, simplified from the network picture. The supplier sells strips to a wholesaler or distributor, who then sell them to pharmacies and a margin is made on each sale. GPs issue patients with a prescription for strips, which they redeem at a pharmacy for strips. The chemist sends the prescription to the PPD (Prescription Pricing Division of the NHS Business Services Authority) for reimbursement, which is given at the cost of the prescription at the drug tariff price, plus an extra amount for dealing with the prescription. The PPD bills the PCT, which in turn bills the GP for the strips prescribed. The GP then sends the money due to the PPD, from their budget. The PCT tenders the strip price with the supplier. Before reimbursement could occur, the PPD had to assess its suitability and include the strip on the NHS Drug Tariff, making it available on prescription in the UK. Strips are supplied to the clinicians such as DSNs who give patients the blood glucose meter and teach them how to use it. Other actors shown include Diabetes UK, a charitable patient body that works for the benefit of people with diabetes, drawing membership from patients and clinicians shown on the picture and an industry body for suppliers, the British In-Vitro Diagnostics Association (BIVDA).

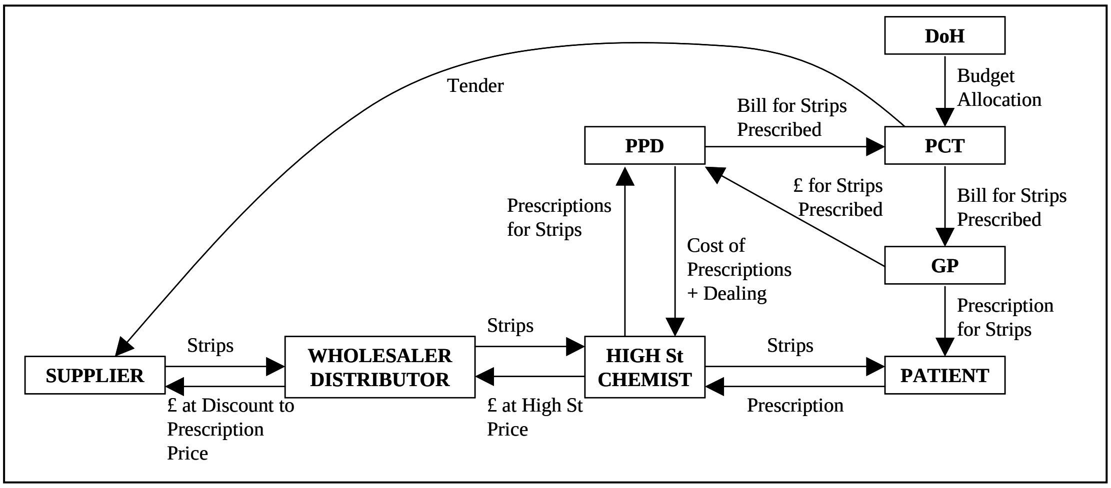

Figure 16. Purchasing and Supply of Blood Glucose Meter Strips

5.4.2. Performance Measurement and Performance Management

This section describes specifically the performance measurement and performance management processes described by respondents, reported in the following two sub-sections.

Performance Measurement Processes

Interview respondents discussed a number of performance measurement processes, measuring a variety of different types of performance of the blood glucose meter. Processes have included technical evaluations by an Evaluation Centre, clinical trials, assessment of the meter for individual patients by DSNs, ease of use and quality assurance assessment at the local level, measurement of costs to the NHS and measurement of sales and various user forums.

Technical evaluations of blood glucose meters on the market, including the product studied in this case have been carried out by the Evaluation Centre, assigned by CEP. This has traditionally involved measuring technical parameters of the product, for example clinical assays that are performed on capillary blood samples from a variety of patients with various blood glucose levels, measurement being made with a reference analyzer. No financial performance measures are used other than listing the cost of the meter, though this is an estimate as price is affected by quantity and strips are typically the main cost.

Few specific customer measures are used, though evaluation outputs make a general comment on the contribution of blood glucose testing to quality of life and issues such as finger pricking. Respondents discussed how CEP are now requesting a new ‘Buyer’s Guide’ product from the Evaluation Centre, containing more purchasing and economic information. Meanwhile, the pharmacy also measure technical performance using similar criteria as the Evaluation Centre.

Technical measures are also used by the supplier’s research and development team and the meter has been sent for clinical trials to determine technical efficacy. Technical measures include reliability, using generic tools, for example the yellow instrument scale and are aimed at ensuring product certification at the European level with CE marking.

The purchasing guide issued by PASA Category Managers and Specialists (NHS PASA 2005 pp10-16) recommends measuring technical and clinical product aspects such as test strip compatibility checks, the risk of cross infection and declared accuracy, as well as various cost aspects. Local level evaluations were also carried out by the Hospital Foundation Trust, which conducted a bench analysis looking at technical measures for quality assurance purposes, with a particular emphasis on product safety features. Measures relevant to the customer in the home market, such as display clarity were also involved.

Strip costs are assessed by the NHS on a national level, by the PPD and by PASA staff, and a cost effectiveness study has been carried out. The PPD also gathered technical performance measurement information from suppliers for assessing suitability of the meter for inclusion on the NHS drug tariff. The onus is on the supplier to provide the information required. The pharmacy also focuses on financial performance measures, studying the profit per line and sales per annum of the blood glucose meter and others on sale in their branches. The supplier also measures financial performance of the meter, the key financial measure being sales per year, where year on year targets are made, with market share also used as a leading indicator**.**

Performance measurement occurs when diagnosis is made by clinicians at the local level, or during a routine appointment. A patient may be given a blood glucose meter by a clinician, so the decision about which of the meters on the market is chosen will be made by the clinician on behalf of the patient. However the DSNs interviewed described how they discuss the various meters available with the patient and make a joint decision with them about the most appropriate one for the particular needs of the patient: *"…it's really horses for courses and that's why we offer the whole range, we wouldn't just go with* [the supplier], [the supplier] *are very good, but there are other meters that would fit the criteria for the patient, so we try to fit the meter to the patient"* and: *"…we go on what the patients are telling us really"* (DSN, Hospital NHS Foundation Trust). In this way the performance of the blood glucose meter is measured in a less formal manner by DSNs, who check through its operation with the patient. DSNs hold discussions with colleagues to supplement their own experience in using the meter with patients. On a local level, there is information sharing and two-way communication between supplier and individual clinician actors. Supplier representatives frequently visit clinicians in the field to give free samples of the meter and discuss any product issues with the user. Other sources that are sometimes consulted for performance measurement information about the meter are medical journals, information from the supplier sales representatives and Diabetes UK.

Many of the performance measurement processes used by the supplier focus on the performance of the meter for the customer, with key performance indicators including accuracy and ease of use. Questionnaires and focus groups are used, with some work outsourced to a dedicated market research organisation. Measures focus on 'soft' quality of life elements such as feelings of positivity or depression of the patient on being diagnosed with diabetes and having to manage their disease. Many of the measures look at feelings of patients both before and after an intervention. The supplier runs a series of symposia and motivational skills sessions with healthcare professionals as part of the blood glucose meter service package, these also being a chance to discover consumer opinions about the product. A database is kept of logged customer reports from the customer care team.

Performance Management Processes

In addition to performance measurement processes, a number of broader performance management processes were evident in the case. These include processing of data from the performance measurement processes just described above and various follow up management activities, such as use of the performance measurement outputs in determining whether to give the blood glucose meter to a particular patient or approve it for listing on the NHS drug tariff. Feedback was gathered and led to changes being made to the product design, as described below.

The technical data gathered by the Evaluation Centre in their technical evaluations was processed including the use of a statistician and double checks for accuracy, compiled in the form of error grids, comparative graphs and tables with other meters and assay and is checked with the supplier for any errors. Evaluation reports have then been produced and a variety of other materials, a particularly popular recent output being a short portfolio comparing key technical parameters selected for clinicians, patients and other stakeholders of blood glucose meters on the market (Device Evaluation Service 2005 pp1-3). While the Evaluation Centre will state that technical results in their outputs for a particular blood glucose meter are acceptable to varying degrees, according to generic scales, they will not issue prescriptive advice on whether to procure a product such as the blood glucose meter or otherwise. As for the purchasing guide produced by NHS PASA, scoring and weighting of the various performance measurement data gathered is advocated with the aim of reaching a purchasing decision. The guide includes sample letters and worksheets for administrating and managing contacts with suppliers throughout a tender process, though no clinicians interviewed described having used the guide. The pharmacy respondent also described how a formulary of blood glucose meters has been produced by a DSN working in practice. At the national level, NHS PASA actors produce a purchasing guide for blood glucose monitoring equipment (NHS PASA 2005 pp1-17). In practice it is predominantly aimed at longer term contracts for blood glucose monitoring in the hospital market, though still has some relevance.

As described above, DSNs play a key role in helping the patient decide on the most appropriate meter for their needs, a process that not only involves determining the performance of the meter for a particular patient and drawing on knowledge gained from other sources, but also taking part in a decision-making process about whether the meter or another is appropriate, a performance management process. This is part of a purchasing process, as the patient or NHS will subsequently buy the strips for the particular meter chosen. Other decisions in purchasing the product are made by the high street pharmacy, who make the decision to choose to list the meter for sale and the PPD, who choose to make it available on prescription.

The high street pharmacy has a committee of clinicians and buyers who discuss various performance measurement data, then make a collective decision about which meters and strips to stock for patients to purchase. Feedback is then given to the supplier about decisions made. The PPD also have a number of key management processes which were involved in assessing whether the blood glucose meter strips should be listed on the NHS Drug Tariff. This involves ensuring the blood glucose meter, or in practice the strip, is safe, of good quality and of appropriate price to be available on prescription. They checked that the product is CE marked for suitability for listing on the tariff, then the strip price was compared with average prices of comparator products as a benchmark. A recent 12% cut in the reimbursement of strip costs of all blood glucose meter strips on the drug tariff was spearheaded by the PPD, who originally wanted a 15% reduction and were involved in negotiations over the price cut, particularly with BIVDA. PPD decisions to list a product such as the blood glucose meter on the drug tariff are made by internal committee and the decision to list the product is made once, rather than in the ongoing management or monitoring processes used by some actors in the case. However the supplier now has to declare the contents of their service package to the PPD, as there were concerns that services would be cut with the strip price reduction and a 15% cut was avoided if the packages from suppliers were kept constant.

As described above, the supplier holds regular review meetings and forums with various customer stakeholders. They see these and the training sessions for patients and clinicians, support lines, website and materials, symposia with healthcare professionals as an important part of managing the performance of their product in practice, making sure that patients and clinicians use the product effectively to manage their disease and are satisfied with it. Diabetes UK also provide help lines which receive 40,000 calls per annum and advice to patient users, for example an annual publication showing the meters available in the UK. The organisation facilitates regular meter calibration, as well as occasional tests where the meter is sent to a laboratory for accuracy testing. Information is distributed to stakeholders, such as in the strip price reduction issue above and recall issues below.

This case also involved some performance management processes concerning technical issues with the design of the product that were encountered in practice. The previous generation of the product was referred to the MHRA who issued a device alert (MHRA 2006a), based on reports from users that the decimal point in the screen display was too small and that blood glucose results could be misinterpreted, particularly by those diabetics with poor eye sight. As a result of the device alert management process, the supplier went through processes of recalling the product, redesigning the screen and replacing the recalled products with the current generation of the meter, free of charge: "[The supplier] *conducted a recall situation on our* [blood glucose meter] *because previous to that most meters in the market place weren't hard locked in milimols per litre, they could be switched between milimols per litre and milligrams per decilitre, because they're being provided to a number of different countries…We had some reports there that, you know, patients had, you know, they thought they'd tested in milimols per litre, they hadn't, it was* *milligrams per decilitre, may have been taking some inappropriate action… So we took the proactive stance of recalling all the meters in the marketplace that were soft locked and replacing them, made them all hard locked.”* (Senior Marketing Manager, Blood Glucose Meter Supplier). Performance management processes were also involved in raising similar concerns about a software function that the previous generation of the product used to change between different metric and imperial scales, the MHRA issuing another device alert (MHRA 2006b). Users found that the product could reset to a default scale following a battery failure, so the supplier underwent a process of improving the design of the product by introducing a hardware scale lock.

5.4.3. Influence on Performance

This section reports on the influence of performance measurement and performance management processes on performance of the meter. As in the previous case, Table 25 summarises the influences found in this case, based on an effects matrix compiled from respondent descriptions of influences of the processes as shown in Appendix L.

A key influence discussed many times by almost all respondents in the case was the influence of information from performance measurement being used in performance management processes, affecting the outcomes of the purchasing decision. Information from performance measurement was used to inform decisions about whether to purchase the blood glucose meter or a competing product. In this case, the various parts of the product are purchased, or given, separately so several decisions were involved. Firstly the strip had to be approved by the PPD following an evaluation, to make it available on NHS prescription. Later decisions involve the pharmacy deciding to stock the meter, or the DSN and patient deciding together which of the free meters given to the Trust by the supplier is preferred. The measurement and management processes vary from subjective assessment of customer preferences by the DSN and patient, through to more formal committee decision making on cost and technical evidence in committees by the PPD for example. Some respondents also went further, describing how the influence of processes in purchasing ensured that the patient user gets the product they prefer.

Influence	Type	Researcher Explanation
Product is purchased or not	+/- F/C	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare. Selection of a free meter will mean the patient then buys the strips for the meter, while decisions to list the meter on the NHS drug tariff and for sale in the pharmacy also enable sales of strips or meters to users to take place.
The best product for the needs of the user is purchased	+ C	Assessment with patient enables the patient to choose their preferred meter from the options available to take away.
Performance measurement information is not involved in the purchasing decision	None	There is little use of information from the technical evaluation in the purchasing decision.
Supplier shows concern over performance measurement	* +/- F	Reports are a good sales device for suppliers, or for competing suppliers. Suppliers have a good relationship with Eval Centre when results are good and vice versa.
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	+ T	Performance measurement and management processes mean that the supplier knows the meter must perform as promised and to regulations it must meet if it is to be sold – IVD, CE marked.
CE marking does not necessarily signify a product that performs to a sufficient standard	- F/T/C	Although some respondents suggested processes help the meter meet standards and perform well, other respondents suggested that the standards are not a good guide to performance and a product that does not perform well may be bought on the basis of limited information.
Used to reduce product cost	+/- F	A % reduction in strip price on national drug tariff was negotiated and achieved on the basis of cost information measured by the NHS on a national level.
Product can be purchased or not for short-term, cost based rather than broader reasons	- F/T/C	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.
Compliance with use of the product is needed	None	The meter can be bought, but if the patient does not use it or the patient does not act upon the blood glucose meter results given by the meter, it will have no benefit for their health.
Training is necessary for patient to gain benefits of product use	+ C	Users require training on the meter if they are to gain the correct results and be able to interpret them, benefitting their health.
Currently little evidence on the effectiveness of the healthcare procedure the product uses	None	There is currently limited evidence of the effectiveness of blood glucose testing as a discipline in gaining beneficial health outcomes, so effort in measuring and managing the performance of the meter may mean that a useless product is procured.
Product design improved	+ T	The design of the blood glucose meter is permanently improved with a new display and hard locked scale.

Table 25. Summary of Influences Identified in the Blood Glucose Meter Case

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

However there were varying accounts of the use made of different performance measurement outputs in the purchasing decision. A respondent from Diabetes UK commented how technical evaluation reports have limited use: *"I'm not convinced that the NHS always use blue cover* [Technical Evaluation] *reports hugely…"* (Category Specialist

Pathology, NHS Supply Chain) and *"One of the problems with* [the Evaluation Centre] *is they do these lovely blue technical reports and nobody reads them. So, you know, how often you can drop it and put it in an oven and whatever, and how accurate they are…the reports just really weren't widely read and that's when we first started working with* [the Evaluation Centre], *a long time ago now, to try and take that information and try and put it into a more accessible format."* (Director Care and Policy, Patient Body). Another respondent commented that technical evaluation information was useful, yet could be hard to get hold of: *"I think we need a larger independent, we need a larger, much more responsive evaluation system…sometimes evaluation papers are not easily available, or you have to pay a lot of money."* (Service Development Manager, Pharmacy Plc). On the other hand, some respondents described how technical evaluation outputs such as leaflets with key performance figures have been well received, the centre running out of stock: *"…that was amazing, we couldn't dish out enough…"* (Technical Evaluation Leader, Evaluation Centre).

Further suggestion that the evaluation reports have an influence is that suppliers of other blood glucose meters are keen to view evaluation and other performance measurement outputs, to describe their own product favourably by comparison to the NHS customer. Respondents from the Evaluation Centre commented that the supplier was willing to take part in technical evaluation because they must gain some sort of benefit from the process: *"There's got to be an advantage for them, to me it's an independent endorsement."* (Head and Biochemistry Director, Evaluation Centre).

From the customer side of the relationship, respondents suggested that performance measurement gives buyers confidence that the product will meet the description: *"…any ongoing performance monitoring should either improve or at least ensure that what you're getting is what they say you're getting."* (Category Manager Pathology, NHS Supply Chain). Not only must the meter perform to specification, it must also meet regulatory standards required for listing on the NHS drug tariff and for sale in the UK. Respondents described the In-vitro Diagnostic Medical Devices (IVD) Directive, as well as CE marking. Although the latter is required to sell the product in the UK, several respondents cautioned against relying on it as evidence of good performance. Indeed it was discussed how buyers of blood glucose meters often only look for a CE mark when assessing the performance of the product prior to making a purchasing decision and may end up buying a product with poor performance, highlighting that these processes can have a non-beneficial influence on performance.

From the point of view of the PPD, the decision to list the product was made following their own assessment of suitability, but as it is always made by benchmarking against existing products, it does not encourage a better performing product: *"…they're* [PPD evaluation processes to approve product on NHS drugs tariff] *sort of designed to compare it against what's currently available, and in a way they don't encourage advances in technology, I mean we would be accepting of advances in technology, we would accept, you know, some additional information to evaluate, but I suppose the process at the moment is more geared up to accepting things that are the same as, but cheaper than currently available products."* (Pharmaceutical Services Manager, PPD). Further, the twelve per cent reduction in strip price reimbursement by the PPD followed negotiations between industry and the NHS on a national level, the latter having decided that expenditure on strips was too high. Indeed many of the respondents described how the meter is bought on the basis of cost and that broader evidence of the performance of the product is not used when purchasing decisions are made, making it hard for products that are not low cost, but have other benefits, to be taken up.

The case also showed the influence of the above processes in re-designing the product. As described above, product recalls, re-design and replacement led to permanent changes in the design of the blood glucose meter and free replacement for the customer. Indeed respondents commented how performance measurement and management processes in general require more minds to concentrate on the meter, so producing a better product: *"…more minds solving a problem will give you a much more rounded result."* (Manager, Point of Care Testing Team, NHS Foundation Hospital Trust).

Another key issue when analyzing the influence of the above processes, as described by a variety of respondents, was that whatever performance measurement processes occur, the meter must be used if it is to perform for the patient by benefiting their health. Also, the patient needs to know how to act properly on meter results if need be: *"Blood glucose testing on it's own doesn't make a patient better, ok, you've got to tie that in with them acting on the result or kind of reviewing the result, so you know, it's part of that."* (Head & Biochemistry Director, Evaluation Centre). Further, some respondents in the case focused on the influence of the patient in performance of the meter, rather than the influence of evaluations. A DSN described how the meter and competing products performed in a fairly similar manner, compared to possible differences from the influence of the patient in using it: *"I think there are differences* [in performance of meters on the market], *I think they're* *less significant than the level of the patient's understanding, not only of the meter but of the principles involved in blood glucose monitoring."* (DSN, PCT).

Studies have suggested that a very small percentage of patients regularly monitor their blood glucose (Evans *et al.* 1999). Indeed one clinician respondent claimed that many of the blood glucose meter results patients present are made up on the bus on the way to the clinic. The customer performance of the blood glucose meter ultimately depends upon the patient user actually using the device in the recommended way to manage their disease. The evaluation centre expressed some frustration that they measure performance and issue reports, yet this alone cannot improve healthcare outcomes, this requires motivated purchasing and healthcare professionals to act on the information. Training the patient in using the meter correctly and interpreting test results was described as important by customer and supplier actors. Indeed the supplier respondent described how their innovative service package was aimed at empowering the patient to manage their disease through training and support, rather than just monitoring their blood glucose levels: *"…if you look at the market now, the blood glucose monitoring market, it's really about measurement, measuring the blood glucose for example, we want to move that to more of a management organisation"* (Senior Marketing Manager, Blood Glucose Meter Supplier).

A challenge described by a number of respondents, including Diabetes UK and DSNs was that there is currently a very limited evidence base on the benefits of blood glucose testing for health. A Health Technology Assessment report and publication (Coster *et al.* 2000a pp70-72, Coster *et al.* 2000b) suggested a lack of evidence of the clinical effectiveness of self-monitoring of blood glucose for the Type 2 form of the condition and that it may not be necessary in all patient cases. However the National Institute of Clinical Excellence guidelines (NICE 2002) state that self-monitoring can be used as part of a wider therapy package. Given the complexity of the disease, care pathway and patient involvement in using the product, it is a challenge to measure and manage the performance of meters in this context: *"…there's so many factors – this is why research is so difficult to actually show the body of evidence on blood glucose monitoring"* (DSN, PCT). This suggests the performance measurement and management processes may have no influence on performance of the meter.

5.4.4. Summary from the Blood Glucose Meter Case

Findings for the case are illustrated in Figure 17. The blood glucose meter case describes an innovative product, with the predominant novel aspect being the accompanying service

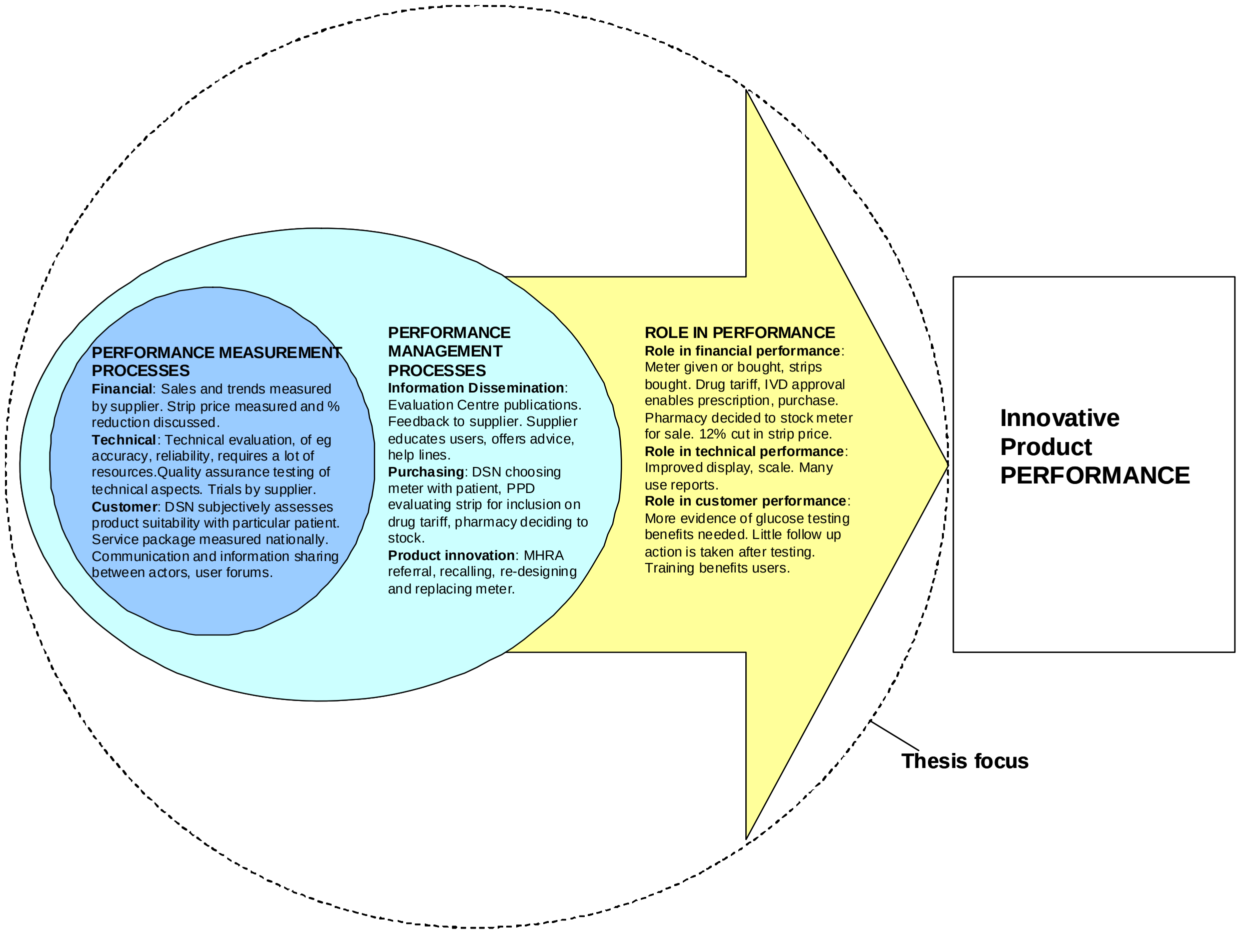

Figure 17. Conceptual Framework Illustrated with Findings of the Blood Glucose Meter Case

support package. Again the case shows that the product is implemented in a complex network of supply relationships and actors. As with the previous case, a broad variety of performance measurement processes take place by the various organisations and actors involved. Technical, financial and soft customer or quality of life aspects of performance were all measured. Again, measurement processes varied from formal, quantitative trials and financial assessments, to informal and subjective assessment and exchange of information by individuals, often oriented to particular user needs as part of the many different purchasing and supply decisions during the implementation of the product.

A number of performance management processes were reported in the case. These included dissemination of performance measurement information and its use in describing how the product performs to make a decision about whether to choose the meter for a particular patient, to sell it in a high street pharmacy, or for approval of the strips for inclusion on the NHS drug tariff. The case also described a couple of instances of performance management processes in identifying the need for and carrying out product re-designs.

The influences of performance measurement and performance management are also suggested by the case, many of which are similar to the influences discussed in the previous case. As in the CT scanner case, a key influence discussed by respondents was whether the meter, or a competing product is adopted for use by NHS clinician and patient users. However the blood glucose meter case showed the influence of processes in a more complex purchasing and supply situation, for example how the PPD decided to list the strips, while DSNs make a decision with the patient to use the best product for their particular needs, which would then lead to subsequent strip purchases. Another influence that was described was that of improving and permanently changing the design of the product, following identification of issues with the display and scales. However this case highlighted the issue of a lack of evidence surrounding blood glucose testing as a whole and that, above and beyond selecting a meter with good performance, that it is no use unless used by a trained user and action taken on the results.

Overall the case is similar to that of the CT scanner, as respondents described the influence of both performance measurement and performance management processes on performance. Also, the findings describe proactive performance management processes of purchasing and innovating the product as having beneficial or non-beneficial influences, however some performance measurement information and outputs are not used in purchasing decisions and have no influence, as in the previous case. Cost is again a key driver of some purchases and information on broader aspects of performance not used. This case also raises challenges that may hinder processes having a beneficial influence, namely compliance with use, training and having sufficient evidence and rigorous standards in the first place. This chapter continues to discuss the next case.

5.5. ECG Monitor

5.5.1. Introduction and Background to the ECG Monitor Case

Findings from the interviews and the respondents to the interviews in the ECG monitor case are shown in Table 26 and in more detail in Appendix M, their roles being described further below. Frequencies of the codes used in HyperResearch are shown in Appendix N.

Respondent (Job Role)	Organization	Type of Stakeholder Role
Director	Evaluation Centre, General Medical Devices	Customer. Influencer, Decider (national level)
Category Manager, Cardiology	NHS Supply Chain	Customer. Buyer, Influencer (national level)
Category Specialist, Cardiology	NHS Supply Chain	Customer. Buyer, Influencer (national level)
General Practitioner	GP Surgery	Customer. User, Buyer, Decider (local level)
Practice Nurse	GP Surgery	Customer. User (local level)
CEO	ECG Monitor Supplier	Supplier (national level)
Chief Technology Officer	ECG Monitor Supplier	Supplier (national level)
Chief Technology Officer	ECG Monitor Supplier	Supplier (national level)
Respondents Interviewed for all Cases		
Policy and Innovation Director	NHS PASA	Customer. Influencer (national level)
Senior Collaborative Development Manager	NHS PASA	Customer. Influencer (national level)
Head of R&D	NHS PASA	Customer. Influencer (national level)
Senior Manager for Technology Introduction	NHS Institute for Innovation and Improvement	Customer. Influencer (national level)

Table 26. Interview Respondents in the ECG Monitor Case

The ECG monitor is a medical device that monitors the electrical activity of the heart over a period of time, recording an electrocardiogram (ECG). The product is intended by the supplier for use in a primary care setting for first investigation of patients with symptoms that may suggest cardiac arrhythmia. It is an ambulatory device, meaning that it is worn by the patient for a period of time while recording takes place. The product consists of a small portable monitor worn by the patient on a belt, pads to attach to the patient and software for interpretation.

The ECG monitor has features that are different from other holter ambulatory recording systems that are mainly used in hospital and cardiology clinic settings. Whereas traditional monitors record a continuous ECG that is subsequently downloaded and analyzed in a semi-automated manner by a cardiologist, the ECG monitor studied here uses neural networking technology, developed at Brunel University, to analyze the ECG in real time as it is recorded by detecting and classifying arrhythmia. The device keeps a summary of the recording that may then be downloaded in a GP surgery. The neural networking technology is novel, suggesting that the ECG monitor is an incremental or modular innovation. The supplier claims that the ECG monitor has the potential to change the care pathway for patients with symptoms suggesting possible cardiac problems, by classifying and analysing data at the GP surgery level, aiding correct diagnosis and appropriate referral decisions by the GP. They claim that waiting times for a test could be reduced, with reduced travelling time and anxiety for patients and faster referral to a consultant if the GP does decide to refer the patient. In the traditional pathway there are risks of expensive false positive referrals to consultants, or of detrimental consequences to patient health with false negative diagnoses. The ECG monitor is exploited for commercial gain by the supplier, a company set up specifically to exploit the technology. Being both novel and exploited, the product is technologically innovative in the light of the literature.

The network picture compiled by respondents in the ECG monitor case is shown in Figure 18. The network of interactions shown is fairly small compared to some of the other cases, including purchasing of the product from the single supplier by a sole customer type within the NHS, the GP surgery. This involves exchange of information, the product and finance in return. A large number of actors on the customer side are involved in influencing the process, particularly by evaluation of the product as it is fairly new to the NHS. The collaborative procurement hubs (CPHs) and NHS Supply Chain are potential purchasers of the ECG monitor on behalf of GP surgeries at the regional and national levels. Other actors keep them informed about the products, though they have not bought any yet and no national framework agreement exists for the ECG monitor from NHS Supply Chain. The ECG monitor is very much the sort of candidate product the NHS III and innovation hubs aim to help gain entry to the NHS, yet the supplier and NHS III are not connected.

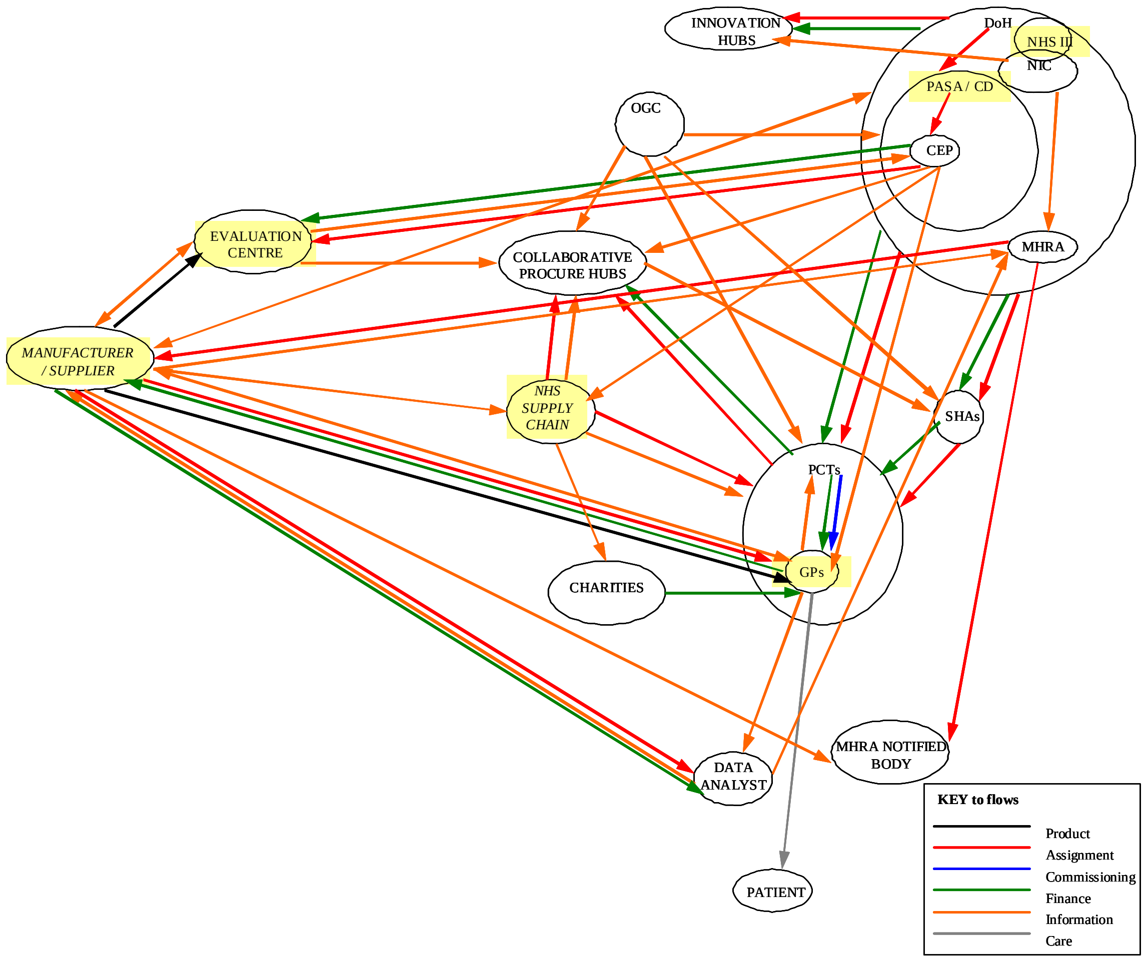

Figure 18. Network Picture for the ECG Monitor Case

5.5.2. Performance Measurement and Performance Management

Performance measurement and performance management processes described by respondents in the ECG monitor case are reported in the following two sub-sections.

Performance Measurement

During implementation, the ECG monitor has undergone performance measurement based on standards and regulations. The supplier has carried out technical measurement to comply with ISO13485 on Medical Devices, US Food and Drug Administration (FDA) Current Good Manufacturing Practice (CGMP) regulations, the Medical Devices Directive (93/42/EC), CE marking and the supplier as a whole is compliant with ISO9000 quality standards that involve measurement of technical performance. Measures focus on safety and quality based aspects of the product, having an emphasis on the procedures followed in producing it. The Medical Devices Directive focuses on the product instead, listing essential requirements that a medical device must meet. Examples of quality measures include the number of defect products overall and measures as precise as the number of dry solder joints in the circuit board. Development project measures of cost, time and quality are also used by the supplier. The supplier also undergoes an annual assessment to meet

US FDA requirements, which involves a documentary audit by a notified body. An independent audit is also conducted for the ISO13485 standard and then sent to the MHRA.

A key performance measurement exercise conducted by the supplier was a clinical trial in a PCT, involving 419 patients over a period of a year (Standing *et al.* 2001). The trial involved independent analysis of data and was published in the *British Journal of Cardiology*. Other clinical and technical trials involving the ECG monitor have been published with the aid of the supplier (Gamlyn *et al.* 1999, Mandal *et al.* 2004).

The evaluation centre was requested by CEP to evaluate the ECG monitor for use in the NHS (Menes *et al.* 2006 pp15-22). PASA had requested an evaluation of the product to verify the impressive claims made by the supplier: *"It was a classic case of a company that saying that they've got this wonderful thing and, you know, you could cut waiting lists by 60%…there never was anywhere you could take these things and say is it true or not, so that's where the power of CEP comes in."* (Policy and Innovation Director, NHS PASA). A protocol for a technical evaluation was developed based upon British and International Standards for medical devices. Technical performance measures included construction quality, frequency response and accuracy of heart rate measurement. Additionally a literature review was carried out because of the innovative nature of the ECG monitor and calculations were made of the financial impact of the ECG monitor in changing care pathways. A user assessment was conducted, involving a structured questionnaire about usage, costs and training provided, with satisfaction ratings calculated. Taking a variety of clinical criteria into account, as well as commercial criteria is advocated in national level purchasing guidance by Category Managers. However respondents reported little performance measurement of the ECG monitor by national level buyers, the device not currently having a framework agreement at NHS PASA or Supply Chain.

Financial performance measures are also important to the supplier, especially sales and profitability of the product as a one-product company. Production costs are measured, in particular the supplier has produced an economic model of the changes to the care pathway and associated costs that the ECG monitor could cause. The claims made as part of this model caused the NHS to measure the financial performance of the product by creating their own model, as described above.

Communication occurred between customer and supplier as part of purchasing and supplying as well as evaluating the product. The GP Surgery where respondents that were interviewed had purchased their ECG monitor when the product was very new to the market and the first of its kind, respondents stating that there was very little performance measurement data available. The supplier visited the GP Surgery to demonstrate the ECG monitor and the GP consulted a Cardiologist colleague in the local hospital for his opinion of the product, also wearing the ECG monitor himself for a 24-hour period. Users are also involved in performance measurement by the supplier, testing the product twice during development.

Performance Management

As well as performance measurement processes, some broader performance management processes were described by respondents in the ECG monitor case, involving dissemination of information, purchasing and supply and improving the product.

The performance measurement data from the evaluation centre evaluation has been disseminated, mainly through publication of the evaluation report for CEP. The evaluation centre involved was prepared to be prescriptive about product performance unlike many others, advising clinicians and purchasers on suitable products to buy when asked, as well as producing more conclusive reports than other centres. Also, the evaluation centre regularly publishes review issues of products in the ECG monitoring field. The supplier has tried many ways to publicise the product, including as a case in the HITF report for example (HITF 2004 pp14). Also, the supplier has distributed information about the product and performance claims over a wide audience, such as at academic seminars, in journal publications (Standing *et al.* 2001), as well as sending audit data to the MHRA. As described above, NHS PASA or Supply Chain Category staff provide purchasing advice.

The supplier has also used processes to manage sales of the ECG monitor. The supplier has introduced a ‘try before you buy’ scheme, allowing GPs in practice, who make the decision to buy the product or not, to use the ECG monitor free for 30 days before having to make a decision. A business case for GPs has been produced by the supplier and interview respondents stated that their GP surgery was given an early ECG monitor free by the supplier in return for feedback for developing the product. Once the ECG monitor has been purchased, the supplier offers training for clinicians in its use and calibrates the product.

In addition to sorting out teething problems experienced by the GP surgery, the supplier has continued to innovate the product, changing several design features. A Corrective and Preventative Action (CAPA) system is used, as part of the ISO9000 compliance. The system involves logging and categorizing customer complaints in files, enabling areas where product improvement is required to be flagged up. In response to information from the CAPA system and feedback from users, the supplier has re-designed aspects of the product such as the battery and electrode systems, permanently changing the design of subsequent products supplied. Also, the supplier annually recalibrates the device as described above, with the aim of ensuring ongoing technical performance.

5.5.3. Influence on Performance

This section reports on the influence of performance measurement and performance management processes as described by respondents. As in previous cases, Table 27 gives a summary, based upon an effects matrix shown in Appendix O.

Many of the influences described were to do with whether the ECG monitor was purchased or not, giving the customer the healthcare benefits of either the device and a new care pathway or their existing care pathway, and giving the supplier revenue or not from sales. Almost all respondents described this influence, referring to a variety of performance measurement and performance management processes. Performance measurement processes having this influence included communication about the device between the GP buyer and supplier, the GP calling a cardiologist colleague to learn more about the device and also testing the device upon himself in a 24 hour period and the supplier carrying out a clinical trial and other technical performance measurement. Also the Evaluation Centre carried out a technical evaluation with the purpose of influencing whether the product was purchased or not: *"The purpose of our evaluation is to help the health service decide whether it wants to buy it or not. Quite frankly I don't really care whether a particular manufacturer benefits or not."* (Director, Evaluation Centre General Medical Devices).

As for performance management processes, the GP on a local level in the NHS makes a decision based upon the information gathered to purchase the product, for example: *"Yes I did* [look at information from the supplier]*, they have quite a hard sell and we fall into it, and I can say that I never regret that, it's a very good tool for diagnostic…no doubt of it."* (GP, GP Surgery). Performance management processes that may have an influence on the customer making the decision to purchase the product or not include the supplier's try before you buy scheme resulting in 90% subsequent sales, the supplier giving GPs a business case to win funding from PCTs, and other dissemination of performance data by the supplier in journals and Evaluation Centre in reports. Respondents described how sales have been low so far, some suggesting that the supplier's evidence is not believed by clinician buyers, while the supplier suggested that NHS funding sources were to blame.

Influence	Type	Researcher Explanation
Product is purchased or not	+/- F/C	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare by offering a new care pathway, or remaining with the existing pathway if better. So far sales have been low.
Product design improved	+ T	The latest ECG Monitor comes with improved battery life, ability to interface with NHS patient records and automated connectivity checking to ensure electrodes are attached. Suppliers get better by evolution after technical evaluation. Teething problems also sorted by the supplier
Performance measurement information not used in the purchasing decision	None	Information from the technical evaluation is not always used in the purchasing decision. Product well publicised but not bought. Easy for supplier to get overburdened with measurement procedures that do not add value.
Feedback to the supplier is not used	None	The supplier ignores or does not use technical evaluation data as it is not dynamic.
Product can be purchased or not for short-term, cost based rather than broader reasons	- F/T/C	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers, hindering uptake. Budget silos. Difficult for supplier to cost training at varied local level.
Supplier shows concern over performance measurement	* +/- F	Evaluation data is of interest to competitors. Evaluation Centre conclusions were not acceptable to supplier.
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	+ T	Performance measurement processes mean that the supplier knows the meter must perform to regulations, as policed by a notified body - ISO13485, MDD (42/93/EU).

Table 27. Summary of Influences Identified in the ECG Monitor Case

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

The evaluation report by the Evaluation Centre did not show the ECG monitor in a favourable light, stating that the evaluation centre does not support purchase of the ECG monitor as a replacement for existing technologies and care pathways following performance measurement, that it could only supplement them. No respondents in the case described using the report from the Evaluation Centre in deciding whether to purchase the ECG monitor or not, however the lack of favourable information about the performance of the ECG monitor and the concerns of the supplier about publication of the report suggest that it will not have a beneficial effect on sales.

Further, the influences of the supplier and Evaluation Centre in both trying to affect the results of the evaluation, trying to manage performance suggest that respondents believe the processes have a performance implication.

The supplier and Evaluation Centre disagreed over the wording of the evaluation report. The supplier did not accept the results of the technical evaluation and also requested different wording in the report: *"The conclusions that we reached weren't entirely acceptable to* [the Supplier]*."* (Director, Evaluation Centre General Medical Devices). Indeed there was a lot of debate between the organisations: *"…so there was a lot of debate, you can imagine, between us, CEP central and the company"* (Director, Evaluation Centre General Medical Devices). The supplier complained at the short-term view taken by the evaluation, stating that current evaluation protocols do not allow opportunity for product issues identified and inherent in any innovative product in evaluation to be rectified. The evaluator could not reproduce all the performance measurement claims made by the supplier from their own evaluation. An example is the claim that the device could change the care pathway for patients presenting with symptoms that could be caused by arrhythmia due to a lack of information on false negative results provided by the ECG monitor, which were not measured in many trials by the supplier: *"We provided everything that we'd got, they then said but we need more information and we don't have that type of information. The trials were never run to their standards, because they introduced some interesting approaches to trials which we'd never seen before in our lives."* (Chief Technology Officer, ECG Monitor Supplier). Also the supplier and evaluation centre used different economic models: "We put an economic analysis together showing the costs of doing our tests compared with common practice, but they introduced a Markov model which said well these are all the possible ways in which you can do things…" (Chief Technology Officer, ECG Monitor Supplier).

There was also the suggestion that the supplier had tried to market the device as a tool for improved diagnosis, however the performance measurement data suggested that the supplier would have more justification and success in marketing the device as a speed of referral tool, according to a respondent at PASA. The comments show the influence of performance measurement data on informing purchasing decision-makers about the product.

Further to the influence of processes in purchasing decision-making as described above, respondents in this case again discussed how information from performance measurement is not always used in purchasing decisions, or that decisions are only made for short-term, cost based reasons on the basis of limited information. As in previous cases, some respondents described how technical evaluation data was not used in purchasing decisions. The supplier stated that the technical evaluation reports are no use to purchasers, as they are not updated to reflect frequent changes to an innovative product. Additionally, the Evaluation Centre respondent also described how the supplier was not prepared to use the evaluation report. NHS national level respondents commented that despite lots of publicity of the product, it was not bought, suggesting that performance measurement information was not used. Mainly national level NHS respondents referred to NHS actors making purchasing decisions for short-term, cost based reasons, where broader evidence of product value is not taken into account by purchasing decision makers. The supplier also discussed the focus on cost, describing the challenge of costing product training where needs vary so much at the local level.

Other influences to do with purchasing of the device were also described. Respondents reported how performance measurement ensures compliance of the product with rules and regulations which enables sales, and that the supplier knows the product must perform to those regulations and declared specifications. Supplier respondents described how technical information is kept and audited by an approved external body to ensure compliance with necessary ISO standards and European regulations.

A key influence described a high number of times by several respondents was the influence of the processes in improving the design of the product. Respondents from the supplier and the customer on both the local and national levels described how feedback to the supplier following the various trials and communications with users highlighted issues with the ECG monitor which were then improved in re-innovation, permanently changing the design of the product. The supplier’s CAPA system was key to gathering feedback and triggering design changes. For example, users found that the ECG monitor had heavy battery usage and that the electrode pads attaching to the patient could come adrift, stopping the product from working. These issues were picked up by the CAPA system, as well as the Evaluation Centre report in the example of the batteries and the battery usage of the ECG monitor was reduced. The latest versions of the monitor have also been redesigned to automatically check for electrical connectivity through the electrode pads, so the user may tell if they are properly secured.

When asked about the influence of performance measurement and performance management, respondents made a number of comments. The Chief Technology Officer at the supplier stated that, on the one hand, measurement is an essential part of evolution and product innovation, helping the company change or die: *"Yes, it* [performance measurement and performance management]*'s essential to strive to improve the product's performance."* (Chief Technology Officer, ECG Monitor Supplier). On the other hand he commented that measurement is a cost and must add value to be worthwhile.

5.5.4. Summary from the ECG Monitor Case

The ECG monitor is a product containing novel neural network technology found in no other competing product. A company has been set up specifically to exploit the product and it is used in healthcare settings for diagnosis, so being both exploited and novel it is an innovative product. Findings from the case are illustrated in Figure 19.

Technical and financial evaluations or clinical trials were carried out by both the supplier and Evaluation Centre, as the product has only been implemented in the market fairly recently. There was some disagreement over methods and results. Informal consultation of colleagues and self-testing the product by the GP buying decision-maker was found, in addition to considering product information given by the supplier, who also assessed customer performance.

Performance management processes involved producing reports and dissemination of information from performance measurement as in the other cases, however in this instance the Evaluation Centre were prepared to offer prescriptive advice on the performance of the product. The supplier used a CAPA system for flagging up design issues, triggering a product re-design, a free product given to the GP Surgery in return for feedback on the performance of the product, while initiatives such as 'try before you buy' are used to try and encourage sales by customers trialling products themselves and making purchasing decisions.

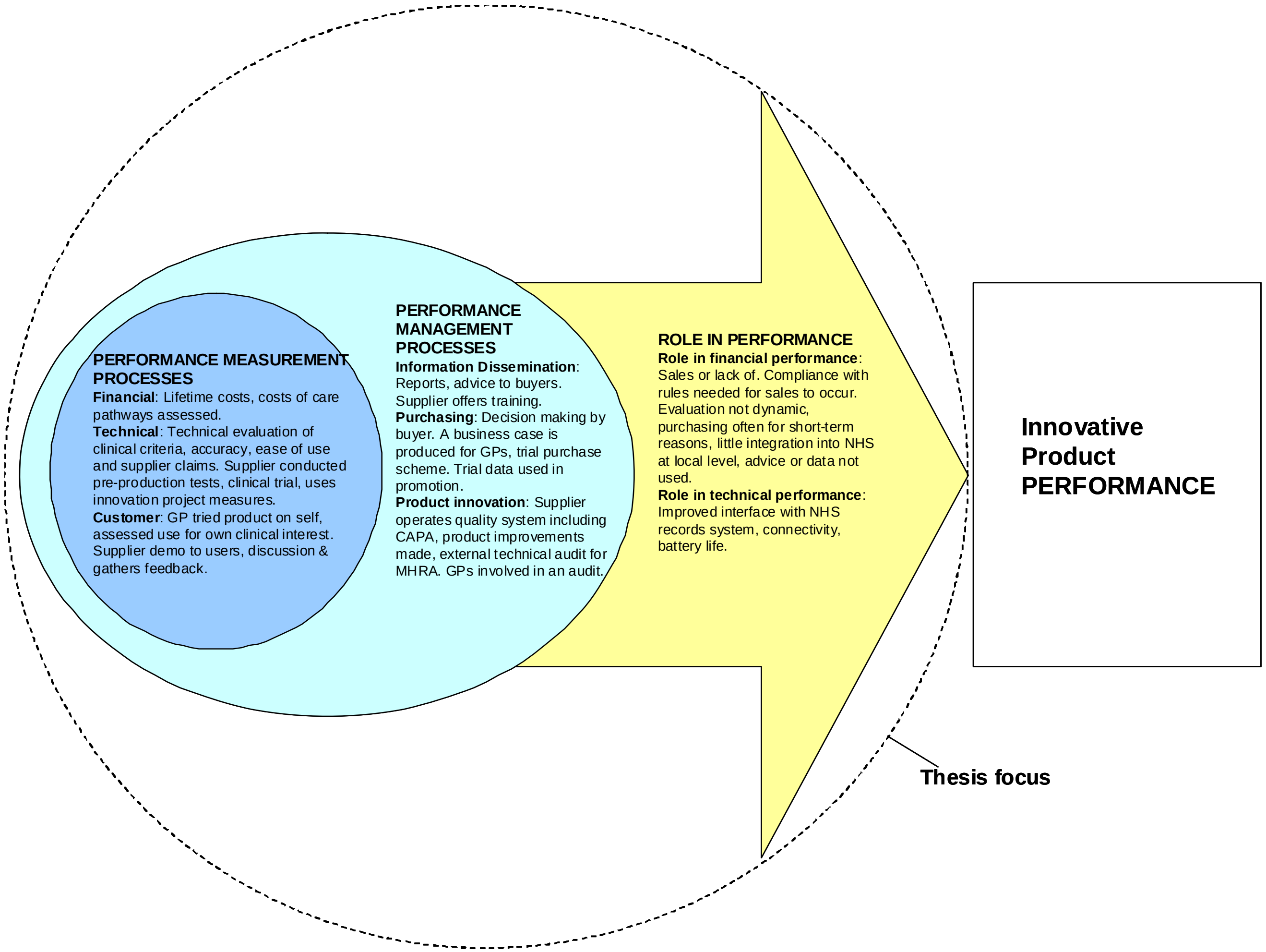

Figure 19. Conceptual Framework Illustrated with Findings of the ECG Monitor Case

Respondents discussed a number of influences of performance measurement and management processes, concerning their influence on the ECG monitor being adopted or rejected, as well as in making design improvements. Respondents described the influence of performance measurement and management processes on the outcome of purchasing and supply decisions and improving product design, but also in a less direct way of encouraging the supplier to ensure the ECG monitor meets necessary regulations to sell the product in the market. Further, a key feature of the case was that the supplier and Evaluation Centre were both found to be competitive about the processes, implying an influence.

In summary, the case highlights issues of measuring and managing the performance of a largely unproven innovative product. It also displays the differences between customer and supplier in the processes used and outputs. Overall, it reinforces the suggestions of the previous cases that not only performance measurement processes but more proactive performance management processes are required if they are to influence performance, whether for the better or worse.

5.6. Standing Frame

5.6.1. Introduction and Background to the Standing Frame Case

Respondents to the interviews in the Standing Frame case are shown in Table 28 and in more detail in the appendices, where a matrix displays the findings from the interviews for this case and frequencies of codes used in HyperResearch are also shown.

The final case studied the standing frame, a medical device designed to assist children with a range of disabilities to gain or maintain standing postural position. The frame consists of a tubular metal frame, wheels, supports and pads for the child and various features to adjust the frame to fit the child and the child within the frame when in use. The frame has cross and chest girths to secure the child into it and a range of optional extras for support and operation are available. It is available in three sizes and can be tailored to the needs of the individual child. Standing frames are used in clinical home and other settings, such as special schools. The standing frame supplier is one of over 70 in the UK market. Fairly few standing frames are bought by the NHS per annum and the cost of the product studied here is usually between £1500 and £2500 per unit.

Respondent (Job Role)	Organization	Type of Stakeholder Role
Research Director	Evaluation Centre, Assistive Technology	Customer. Influencer (national level)
Centre Manager	Evaluation Centre, Assistive Technology	Customer. Influencer (national level)
Centre Manager / Occupational Therapist	Evaluation Centre, Assistive Technology / University	Customer. Influencer (national level) / User, Buyer, Decider (local level)
Lead Category Manager, Assistive Technology, Special Projects	NHS PASA & DoH	Customer. Buyer, Influencer (national level)
Category Specialist, Mobility & Telecare	NHS PASA	Customer. Buyer, Influencer (national level)
Paediatric Physiotherapist	Hospital NHS Foundation Trust	Customer. User, Buyer, Decider (local level)
Paediatric Physiotherapist	Primary Care Trust	Customer. User, Buyer, Decider (local level)
Physiotherapist	Primary Care Trust 2	Customer. User, Buyer, Decider (local level)
Managing Director	Standing Frame Supplier	Supplier (national level)
Director General	British Health Trades Association	Supplier Industry Body (national level)
Chairman of Seating & Positioning Division	British Health Trades Association	Supplier Industry Body (national level)
Respondents Interviewed for all Cases		
Policy and Innovation Director	NHS PASA	Customer. Influencer (national level)
Senior Collaborative Development Manager	NHS PASA	Customer. Influencer (national level)
Head of R&D	NHS PASA	Customer. Influencer (national level)
Senior Manager for Technology Introduction	NHS Institute for Innovation and Improvement	Customer. Influencer (national level)

Table 28. Interview Respondents in the Standing Frame Case

The standing frame in this case is considered to be technologically innovative as it is commercially exploited by the supplier and has features that are novel to the market, such as the ability to adjust the frame between prone and supine positions using an electric hand control. These features represent incremental design improvements. Therapists also described novel features of the Frame as including two different split knee blocks for improved adjustment and the tilt table type frame, which enables a larger child to be hoisted into the frame.

The network picture in Figure 20 shows the main actors and flows between them, identified by respondents in the case.

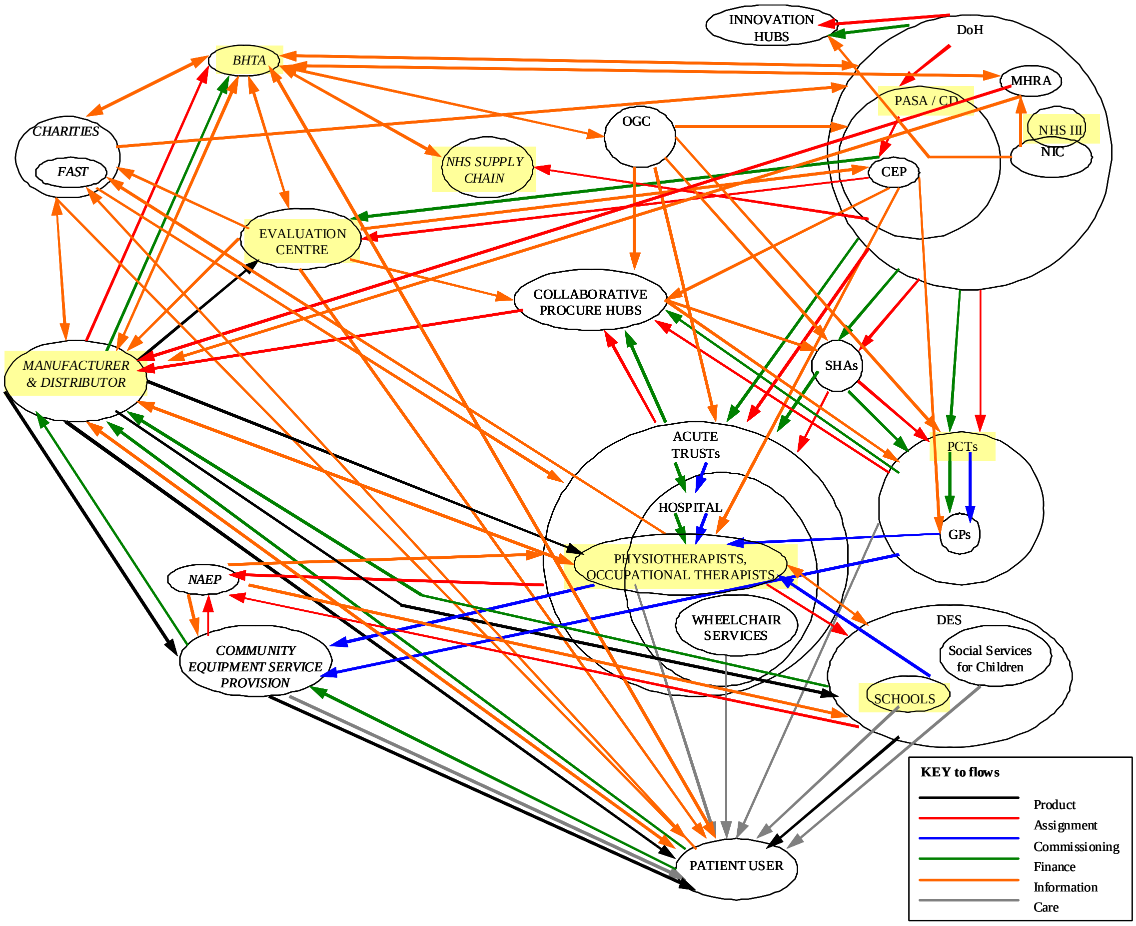

Figure 20. Network Picture for the Standing Frame Case

Actors at the local level such as therapists and parents make decisions about whether to purchase the standing frame for either a particular child, or a group of children attending a special school for example. The supplier has a team of field based sales representatives who visit potential purchasers in Trusts with the products. On the regional and national levels, the collaborative procurement hubs, NHS Supply Chain and PASA are active in buying assistive technology products, however there are currently no national framework contracts for the standing frame and no purchases have been made, although actors have information about products.

Other actors in the network who influence the implementation of the product include the British Healthcare Trades Association (BHTA), an industry body representing the interests of the supplier and others in two-way communication with the customer. Community Equipment Service Provision also provides the frame, care and assistive technology products at the local level, being commissioned by Trust actors. The National Association of Equipment Providers is an association representing actors involved in community equipment provision.

5.6.2. Performance Measurement and Performance Management

Performance measurement and performance management processes described by the interview respondents are described in this section, under the following two sub-headings.

Performance Measurement

Technical evaluation also occurred in the standing frame case, where the Evaluation Centre carried out a comprehensive technical evaluation of standing frames, including the frame studied here, on behalf of CEP. The standing frame was evaluated as part of a group evaluation of frames suitable for children (Daniels *et al.* 2004) in which the features of frames were evaluated, rather than the frames themselves, so although the group evaluation featured a number of frames, it was not a comparative test. Evaluation centre respondents stressed this approach is important in the assistive technology field where the performance of a product depends upon the particular patient who uses it and the particular use to which they put it: *"I couldn't say that, it will never be, we will never be comfortable with a Which? Guide where it says that the* [standing frame] *size 3 is the best...it isn't that simple unfortunately."* (Research Director, Evaluation Centre). A literature review was then carried out, a product sample was borrowed from the supplier and a multi-disciplinary technical assessment was carried out according to the requirements of a standing frame. This takes the form of physical tests on support of various parts of the body, manoeuvrability, stability, storage and aesthetics. Technical performance measures on product parameters such as stability are also used by the supplier as part of research and development of the product. The supplier gathers clinical evidence of the benefits of standing with products such as their own frame.

To carry out the technical evaluation by the Evaluation Centre, a consultation group of stakeholders was convened who developed an evaluation protocol through consultation to determine what the market needs are for a standing frame. Indeed the methodology used was multi-disciplinary and also involved measuring aspects of customer performance. The 'QUEST' method of determining user satisfaction was used, as well as in user diaries that were used as a performance measurement methodology. Customer performance information is also gathered by supplier sales representatives working in the field with children and clinicians.

Another process discussed by many respondents concerned clinicians measuring customer performance of the standing frame at the local level. Users at the local level such as physiotherapists measure the performance of the frame for the needs of a particular child, by helping the child to try out the frame, often with the help of a supplier representative and often with another couple of competing products. The assessment is subjective rather than objective, for example the therapist will look at the alignment of the child in the frame and will largely be able to tell from experience whether it is correct or not: *"They* [aspects of performance of the standing frame for a particular child]*'re mostly subjectively assessed, because an assessment isn't really long enough to know for certain about any of these things or to measure them really, but you are just simply looking at, how does that look…we are just simply looking at do they look better in this standing frame or that standing frame."* (Physiotherapist, Primary Care Trust 2). Assessing comfort could involve talking to the child, or if the child has difficulty communicating, measures such as their temperature, facial expression and vocalisation are observed. Established measurement tools and scales are used, such as a goniometer for assessing angles and the Waterlow Scale for assessing pressure sore risk. The ability to use the product for more than one child is also important to many users, so adjustability is a key aspect of customer performance measured. As part of the assessment the therapist may also look at patient x-rays for example, which while not strictly a performance measure of the frame as a product, is a part of determining its performance for the child in question. Additional measurement tools include digital photography to record the fit of the frame for a particular child.

Therapists stated that they get to know supplier sales representatives as they exchange information and the representatives pay visits when the frame is assessed. The supplier sales representatives work with therapists, who described them as supportive and driven by the need to get the best product for the child in question, sometimes even concluding that it is not an appropriate product, despite missing out on a sales opportunity as a result: *"We've got a good working relationship, but I don't think they're in your face, and the other thing about* [the supplier] *which I like as a company is that if the product does not work for the child, they will not sell it."* (Paediatric Physiotherapist, Hospital NHS Foundation Trust).

A number of sales and profitability of the product line are recorded by the supplier. However, financial performance measures were not used in the Evaluation Centre evaluation other than noting the product price in the report, once performance measurement had taken place. National level actors in NHS PASA and NHS Supply Chain focus on financial performance measures, especially cost.

Performance Management

In addition to the performance measurement processes, broader or follow up performance management processes were identified by respondents in the case.

Many performance management processes involve disseminating performance information from measurement. The evaluation centre are not prescriptive on the basis of their evaluation and do not recommend or otherwise any products in particular. However a number of reports on the evaluation are issued to CEP, through whom they are made available to other customer or supplier actors. There is a main evaluation report (Daniels *et al.* 2004 pp5-6), a lay summary and a number of published articles (Daniels *et al.* 2005) in both double-refereed academic and professional journals. Further methods of dissemination of information include conference presentations and training and development programmes for clinicians and users. Participants in the evaluation study are asked what kind of feedback they would like and suppliers are asked for written feedback, which is then published in the main evaluation report. In addition to the evaluation reports, a number of performance management tools are provided by the evaluation centre to enable other customer actors to determine whether the standing frame or other competing products are the most appropriate for their needs. This includes a comprehensive website with an online database that is searchable for frame features and then links through to the appropriate standing frames. Recent advances to this database have included a funding algorithm and a decision tree.

Another performance management process involving dissemination of information that was described in this case, as in the previous ones, was national level NHS actors issuing advice and guidance to purchasers. Category Managers and Specialists in NHS PASA or Supply Chain pointed out how they issue information such as template documentation. These respondents also described how information from performance measurement of the product against standards and regulations is checked to ensure assistive technology products such as the standing frame are suitable for purchase. For example, the presence of a CE mark is checked before a purchase can take place.

Purchasing the standing frame also heavily involves performance management processes. As for therapists, assessing the suitability of the Standing Frame for a particular child is part of not only a performance measurement process but one of managing performance as well, as the standing frame is adjusted to tailor the product to the needs of the child. Therapists consult with other colleagues, clinicians, carers and the children themselves, following making their own assessment, to determine the best standing frame for a particular child. Supplier products and catalogues as well as outputs from the Evaluation Centre are also kept in hospital departments for reference. In addition to these performance management processes of purchasing and supply decision-making, therapists also discussed the broader processes involved in ensuring the product is purchased. Therapists, special school staff and other users have used performance measurement data to create funding justification documents, with information from the supplier. For example, one physiotherapist, having decided on the most suitable standing frame, will approach the relevant hospital consultant for funding with evidence of the effectiveness of the frame for the child: "*What happens within this department is you approach the consultant for some money for a standing frame…*" (Paediatric Physiotherapist, Hospital NHS Foundation Trust).

Feedback occurs during the communication and visits between supplier representatives and clinicians. Supplier staff have a weekly meeting to discuss the feedback gathered from users as described above, also discussing possible product changes. Many respondents stated that the supplier has modified the frame following user feedback, such as by introducing the electric tilt control and split knee blocks. Further, the supplier has customised the product for individual users following attending user assessments with the physiotherapist and a particular child, for example one physiotherapist stated how a customised head support had been sourced by the sales representative. In addition, the supplier operates product training and support through their network of sales representatives, to ensure that the users of the frame operate it correctly for their needs.

5.6.3. Influence on Performance

This section reports on the influence of performance measurement and performance management processes as described by respondents. A summary is shown in Table 29 based on an effects matrix in Appendix R, as used in the previous cases.

Many respondents described the influence of performance measurement and management in whether the standing frame was purchased or not, discussing how therapists are influenced to choose the standing frame or a competitor product and use information to justify funding for the frame once that choice has been made. The main processes that therapists described as having this influence were the subjective assessment and decision making about how suitable the frame was for the needs of a particular child. However a focus on cost, rather than broader aspects of performance, by purchasing decision makers on the national level of the NHS was discussed by several respondents. Some described how standing frames are viewed as commodity products, whereas therapists discussed how they can have selected the frame that performs best for a particular child, only to be refused funding to purchase it.

Influence	Type	Researcher Explanation
Product is purchased or not	+/-	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare by offering a new care pathway. So far sales have been low.
The best product for the needs of the user is purchased	+	The performance information used and the process of making the purchasing decision gives a particular child the best standing frame for their individual needs.
Product meets needs of individual user as it has been customised with special features for the particular purchase	+	Supplier customises the frame with features such as alternative headrests and straps to tailor it to meet the needs of a particular child.
Product can be purchased or not for short-term, cost based rather than broader reasons	-	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.
Information not used in the purchasing decision	None	Information from performance measurement and management processes is not used in the purchasing decision. The product may be bought for all sorts of reasons other than on the basis of performance measurement information. Technical evaluation outputs may be late, not prescriptive enough. Assessing the frame for children's diverse and changing needs is challenging.
Product design improved	+	The design of the standing frame has been permanently improved, for example through new split knee blocks in response to user feedback.
Feedback to the supplier is not used	None	If feedback of performance measurement information to the supplier is not used proactively, it will not have an influence on performance.
Compliance with use of the product is needed	None	If the standing frame is to perform for a child and be effective in aiding their health, it must be used once purchased.
Training is necessary for patient to gain benefits of product use	+	Training of users is important if the standing frame is to be used correctly and the child is to gain the healthcare benefits of using the frame.
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	+	Checking performance against regulations mean that the supplier know and ensure that the product must meet a certain standard. Evaluation by the customer encourages the supplier to ensure the frame performs as they claim.
Supplier shows concern over performance measurement	***** +/-	Suppliers show concern that performance measurement data will affect their competitive position or sales. Supplier use evaluation information to make their product more competitive compared to others Technical evaluation raises the profile of assistive technology and organisations involved.

Table 29. Summary of Influences Identified in the Standing Frame Case

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

The challenges of measuring the performance of a specialist product category that respondents representing the industry believed should not be treated like a commodity were described. Further, the NHS PASA Category Specialist described a 12-month budget period over which the books must be balanced, giving the relationship a short-term view: *"…if their* [children's] *needs are actually addressed immediately and to the best of ability, obviously there's potential long-term savings there. Now I appreciate that that in some kinds of eyes is perhaps not the way things are actually looked at, because the way that budgets are set and everything it needs to be looked on a 12 month period..."* (Category Specialist, NHS Supply Chain).

Once purchasing had taken place, a point discussed by both Evaluation Centre and therapist respondents was that compliance with use of the frame by children and carers is essential if the frame is to perform for that child, improving their health. This may involve training users.

Respondents had mixed views about the influence of outputs from the evaluation conducted by the Evaluation Centre. One therapist who had been involved in the evaluation commented that she had changed her clinical practice as a result of the process, helping to purchase the most appropriate frame for the needs of a particular child: *"…my clinical practice changed as a result of the work that I did at* [the Evaluation Centre] *around the questions that I ask the children, personally I got an awful lot out of having done that piece of research work, because I'd never done any research previous to that…I think I probably don't make as many assumptions now as I used to."* (Paediatric Physiotherapist, Primary Care Trust). Respondents involved in the evaluation also commented that it exposed products to them of which they were previously unaware and that the evaluation raised the profile of assistive technology patients and products such as the standing frame in particular, which are sometimes perceived as a 'Cinderella' product.

However another therapist who did not take part in the evaluation suggested the report was not used much: *"…although we did read that, it wasn't enormously helpful to us, because I think the number of products that we used had evolved since they'd done all the, I mean a department somewhere had gone to a lot of lengths doing it, the other thing that it didn't take account of was the individual situation with respect to specific patients…"* (Paediatric Physiotherapist, Hospital NHS Foundation Trust). Other physiotherapists were not aware of the evaluation centre report, so could not use any of the performance measurement information in their decision-making on purchasing and finding a suitable product for the child. A respondent at the supplier suggested that the evaluation outputs were no use as they were not prepared to be prescriptive: *"…it was disappointing in the way that we were all hoping for much more definitive conclusions to come out of the study, for both what we call prone and supine standing…while they came to some conclusions they finished it off by saying it was inconclusive which really negated the whole exercise."* (Managing Director, Standing Frame Supplier). Again, the post change programme outputs from CEP and the Evaluation Centres are intended to be more prescriptive, however the findings here refer to the outputs available at the time of the cross-sectional study. Overall respondents also stated that performance measurement could have an effect on purchasing and supply decision making to adopt the product: *"It can have a very dramatic effect on sales, good and bad."* (Chairman of Seating & Positioning Division, BHTA).

In addition to the processes of assessing the suitability of the frame for a particular child and then making a decision on the basis of the assessment, the supplier and therapists have made other technical changes to the design of the frame. Two dedicated staff at the supplier and a system for customer feedback are involved, including meetings between R&D and marketing staff to review and prioritise feedback at the supplier's head office. For example, feedback from representatives and as part of the technical evaluation process has resulted in a new split knee block being added to the frame in response to user wishes. Other respondents commented how feedback must be used for the information involved to have an influence on performance, for example by making design changes, reinforcing the previous point.

On a related note, the process of the supplier CE marking the Standing Frame, as well as any associated regulatory reporting processes was described as important to ensure production of products that perform well and to meet performance claims and regulations: *"The CE marking procedure and the issue you have in terms of reporting, particularly of, obviously accidents or anything of that nature, or failures, product failures are vital to the industry as a sector to make sure it gets right."* (Director General, BHTA).

As well as describing an influence in changing the design of the product, respondents also discussed how the standing frame is modified for individual users on a sale by sale basis. Therapists gave examples of the supplier customising the frame by using alternative headrests and straps, making the product more appropriate for the needs of a particular child: *"They* [the supplier]*'ve certainly done one off alterations to things, I've had different* *straps made for particular children, some different types of head support…*" (Paediatric Physiotherapist, Primary Care Trust).

As in previous cases, respondents from the supplier and evaluation centre described how the supplier takes an interest in the results of the technical evaluation for example, being concerned how this affects the competitive position of their product, such as in the above quotes from the BHTA respondents. Additionally, respondents involved in the technical evaluation described how it had raised the profile of the Trusts involved and assistive technology in general, as described above.

5.6.4. Summary from the Standing Frame Case

Findings from the case are illustrated in Figure 21. The standing frame case studies a medical device with novel features, such as the design of the knee blocks and electric control, which is exploited for profit by the supplier and for benefiting the health of children with a range of disabilities. As with other cases, most interaction and purchasing and supply decision making occurs on the local level, though respondents described a large range of organisations involved in implementation of the standing frame.

Performance measurement of the standing frame occurs at the local level, where therapists try out the suitability of the product for individual children in a subjective manner with information and visits from the supplier. The assessment is driven by the unique nature of every patient case and child's needs and focuses on customer and technical performance. This issue also drove measurement of technical and customer aspects of performance on a national level by the Evaluation Centre. Financial performance of the frame was measured on the national level, focusing on cost.

Performance management processes were also described by respondents, such as the purchasing and supply decision making process and the adjustment of the standing frame by therapists and supplier representatives to fit a particular child, as well as longer term modifications to the product, such as the new split knee block. Performance management processes also included the preparation and dissemination of outputs from performance measurement.

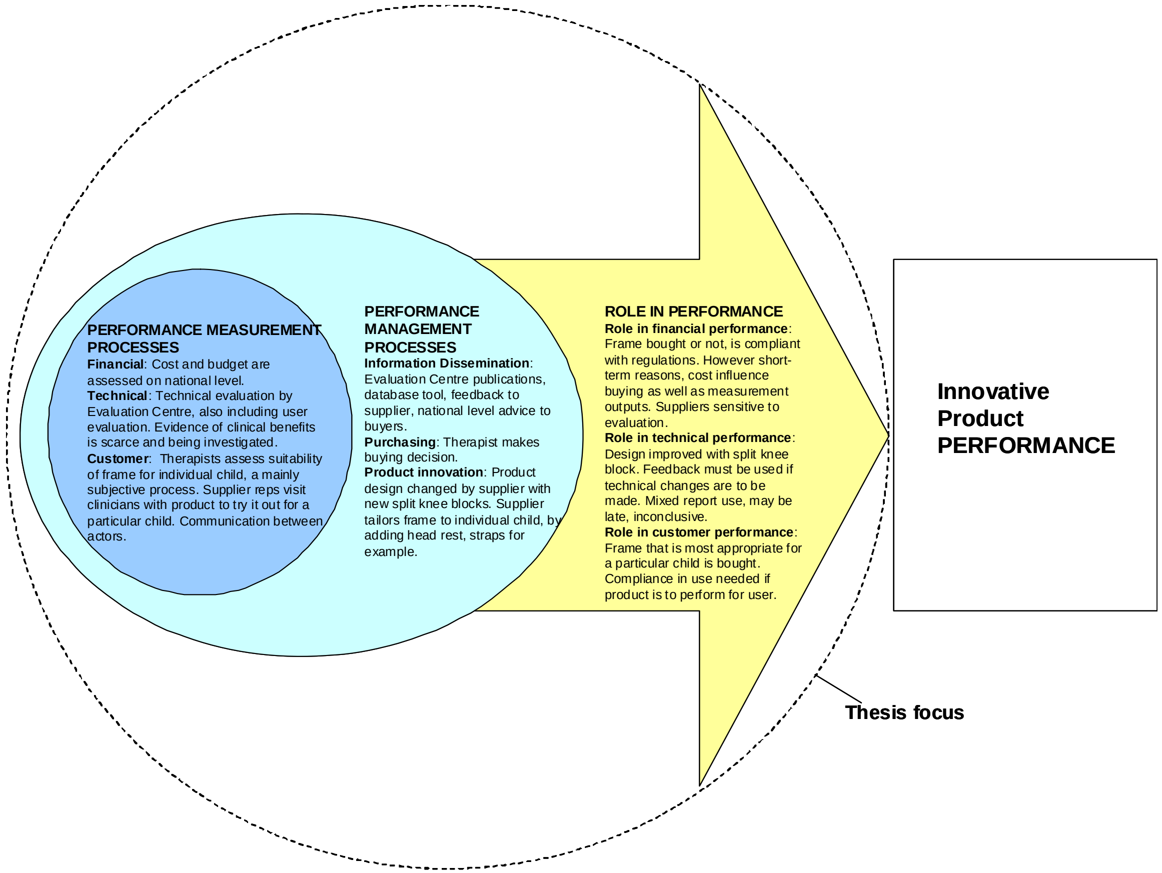

Figure 21. Conceptual Framework Illustrated with Findings of the Standing Frame Case

Influences of the performance measurement and performance management processes on performance of the standing frame include a beneficial or non-beneficial effect on sales, as well as technical improvements that were made to the product at various stages of implementation of the innovation. For the frame to perform well for the user, the influence of purchasing decision making in ensuring the most appropriate product for the particular child's needs and ensuring compliance with use were described. Respondents also described a number of processes with influences that are involved with the other influences above, such as the influence of a funding justification letter or ensuring that the frame meets supplier's claims in purchasing the frame. As in previous cases, the roles suggested by respondents highlight that not only performance measurement but also more proactive performance management processes are involved if there is to be an influence on performance of the standing frame. While influences of performance measurement processes were described, such as the technical evaluation opening the eyes of a therapist to new products, additional performance management processes would be required for an influence on performance to occur, such as the clinician procuring the product as a result.

The final section of this chapter briefly draws together a summary from all four case studies.

5.7. Summary from the Four Case Studies

This chapter has reported findings from the four empirical case studies. Four different innovative products were described, all of which have a novel feature and were exploited by customer and supplier actors in some manner.

All the innovative products were implemented in a network of supply relationships, in particular between the supplier and NHS as customer. A broad variety of organisations and actors were described in all four cases. The interaction between many actors includes exchange of information about the products and social exchange. Purchasing and supply decision-making to adopt the product mainly occurs by actors on a local level in Trusts at the current time, however national level actors and organisations are also involved. Purchasing decision-making leads to exchange of the product and finance.

The cases highlighted that a broad range of performance measurement processes occur. Actors measured financial, technical and customer aspects of the performance of the products, with some actors often focussing on one or two of these. The processes particularly occur at the point of purchasing and supply by the end customer, though also at other times throughout the implementation of the innovative product. They are variously objective, formal and regulation driven such as technical evaluations or clinical trials, or subjective, informal and user driven, frequently involving social and informational exchange between local level actors.

Respondents in the cases also discussed a broad range of performance management processes that follow up or are additional, broader processes than the performance measurement processes described. All cases discussed disseminating information from performance measurement and showed how the design of the product has been permanently changed following performance measurement. Respondents in all cases described making the decision of whether to purchase the product or not, possibly against another competing product. The particular nature of many of the broad processes sometimes differed by case, for example making the purchasing decision involved a formal tender process in committee as in the CT scanner case, or alternatively subjective decision making by individual clinicians, as in the standing frame case.

Respondents described a number of influences of the performance measurement and management processes, such as in the outcome of the purchasing decision and changing the design of the product permanently. On a similar theme, processes were also described as having an influence in purchasing the best product for a particular customer and in the product being purchased or not for short-term, cost based reasons. Influences were also described with respect to compliance with product use, training, feedback and actors showing concern over performance measurement results.

Some of these influences were described as having a beneficial or non-beneficial effect, for example the use of performance measurement information in purchasing decision-making helps buying a product that performs better for the customer and results in sales for the supplier, though if the product of another supplier is chosen, then the process will have a non-beneficial effect for the supplier of the product studied. A non-beneficial influence could occur for both supplier and customer if the decision is made on the basis of cost information alone. The cases also showed that some of the processes described by respondents may not have had an influence on performance, there being conflicting evidence of whether technical evaluation outputs were of use to decision makers or not. Also, the importance of using feedback was highlighted if it is to be of use. Respondents in the blood glucose meter and standing frame cases highlighted the importance of performance management processes of training and use of the product by the patient or clinician if it is to perform for that patient. Additionally a limited body of evidence on the effectiveness or performance of these products exists, suggesting limitations to the influence of performance measurement and management processes on performance.

Overall, the cases suggest that in comparison to the performance measurement processes, more of the performance management processes were described as having an influence on performance. This suggests that both performance measurement and performance management processes are required if they are to have an influence on performance. Especially, the data suggests that those processes described as having a beneficial or non-beneficial influence involve proactive, decision-making use of information from performance measurement processes, by buying and selling or innovating actors. Non-beneficial influences were described as occurring when only limited use of performance measurement information, with a focus on cost, was made in the purchasing decision. The customer does not buy a product that performs in a broader way than just being low cost. Non-beneficial influences also occurred when the supplier lost sales by the customer deciding not to purchase their product, though the customer had the benefit of a competing product. In contrast to the influences just assessed, where no influence occurred processes involved less proactive use or no use of performance measurement information by buying and innovating actors. Again, this suggests that both performance measurement and performance management processes are required if they are to influence performance.

Whereas this chapter has reported on the data gathered within each of the four case studies separately, the next chapter of the thesis continues by taking a cross-case view of the data gathered, before discussion in the light of existing work in the following chapter.

CHAPTER SIX: CROSS-CASE FINDINGS

6.1. Introduction

The previous chapter described the findings from each of the four empirical case studies. This chapter continues the thesis by reporting on the findings across the four cases. It compares the findings from each case, illustrating similarities and differences between them. The headings used to structure this chapter are the same as those used in the individual cases and are based on the research questions, which were in turn based on concepts in existing work. Key findings from across the cases about the background of the innovative products, performance measurement and performance management processes are reported. As in the last chapter, processes are differentiated according to their definitions in the conceptualisation, concentrating on performance management as being broader. Their influences on performance are then reported and several alternative groupings of this exploratory data from across the cases are tried. A summary is drawn from the cross-case analysis, before the next section of the thesis discusses the findings with regard to existing literature and knowledge.

6.2. Introduction and Background to the Innovative Product Cases

The innovative products in the cases vary in a number of characteristics, including the novel features, though they are all exploited by the supplier for financial gain and by the NHS for use in healthcare. Key features of the innovative products are summarised in Table 30.

All the products have some novel feature and are exploited in some form or another. Novel features vary from physical features of the product (standing frame), technologies in the product (ECG monitor) to the associated service package (blood glucose meter). The products all feature incremental innovations introduced since the original launch, whether the development of a new version of the product, or additional features. There are differences in how widespread implementation of the product has been, from the blood glucose meter which is one of the most popular products in a huge UK market, through to the ECG monitor which has currently only been bought by a minority of GP surgeries. The unit price of the products varies greatly, highlighting the challenges of evaluating products financially given their differing use rates, numbers of patients who could use the product and whether they are paid for per use or outright at the time of purchase. The individuality of each product is also emphasised by the diversity of care areas and the finding that products such as the multi-slice CT scanner can be used across a variety of care areas. All four case study products are innovative, but there are many contrasts between them in level of implementation, care areas, cost, application and confidence in the effectiveness of the clinical activity that they are involved in.

Product	**Multi-Slice CT Scanner**	**Blood Glucose Meter**	**ECG Monitor**	**Standing Frame**
Novel feature	Software package enhancements compared to competitors. Gantry angulation that enables helical head scanning. workstation features.	Accompanying service package including DSN staffed help lines, lifestyle advice, training courses.	Neural network technology that analyzes and classifies heart arrhythmia during the test	Standing Frame adjustable between prone and supine positions using electric hand control and tilt table type frame. Split knee blocks.
Exploitation	Profitable product for supplier Diagnosis and treatment planning healthcare benefits for NHS customer.	Product profitable for supplier until costs of recall were incurred Possible improved control of the disease for patients and clinicians.	Company set up specifically to exploit product Faster, cheaper patient diagnosis in GP Surgery setting, claims of improved accuracy of referrals.	Profitable product for supplier, claimed physical and physiological benefits for patients.
Time Product has been Launched	The Scanner is the latest version of the supplier's multi-slice CT scanner, with more 'slices' and package enhancements. Latest version on the market since 2005.	Latest version of the supplier's blood glucose meter, has been on the market since late 2005/early 2006 .	On the market since about 2000, though upgraded versions have been produced in that time. So far bought by a small minority of GP Surgeries.	On the market since about 1995, though has been upgraded in that time. 150 to 200 sold per annum.
Care Areas	Many applications, including trauma, cardiac, oncology	Diabetes	Patients presenting with symptoms of cardiac problems	Assistive technology for children, range of disabilities
Approximate Cost	£500,000 to £750,000	12-17pence per strip	£1,000 to £1,500	£1,500 to £2,500

Table 30. Key Features of the Innovative Products from the Empirical Cases

A meta-matrix (Miles & Huberman 1984 pp151-167) summarising the findings across the four cases was developed from the coded data and can be found in Appendix S. The matrix is a conceptually clustered, un-ordered type, the conceptual clusters being based on question forming areas of the interview guide, the research questions and the conceptual framework, driven in turn by the existing literature. A table in Appendix T also shows occurrences of codes used across the four cases, both as a total for the case and for the total number of respondents whose accounts were given a particular code. Figure 22 in the conclusion of this chapter shows the conceptual framework illustrated with cross-case findings.

The network maps shown in the previous chapter highlight that all the innovative products are supplied by a private sector supplier and bought by the NHS as a customer. Purchasing and supply decisions about the four products were made at the local level in Trusts, with only approval of blood glucose meter strips for inclusion on the NHS drug tariff by the PPD and the Pharmacy decision to stock the meter for sale in the blood glucose meter case as exceptions. Purchases of the CT scanner were previously made on the national level, but are now made on the local level. Respondents who helped construct the network maps also described a number of national and regional level organisations that are, or could be, common to all networks. These similarities include the Department of Health (DH), Strategic Health Authorities (SHAs), the Purchasing and Supply Agency (PASA), other policy setting and implementing organisations such as the Medicines and Healthcare Products Regulatory Agency (MHRA), as well as more distant organisations with a policy based role in the supply network, such as the Office of Government Commerce (OGC). NHS Supply Chain and the Collaborative Procurement Hubs (CPHs) are both new organisations acting for the NHS in a buying role on the national and regional levels respectively. However the roles of these organisations was unclear to respondents in all four cases, given the recent changes in NHS purchasing and continuing uncertainty. NHS Supply Chain Category Managers and Specialists offer purchasing advice and guidelines, though there was limited use of these at the local level where purchasing decisions were being made and none of the four products is available on a national framework contract. CEP and the evaluation centres have a role in each case. This is not surprising as the cases were initially accessed through the centres, however the fieldwork discovered that the centres were widely networked within each case and respondents who were contacted independently acknowledged the existence of the centres. Respondents in all cases discussed the role of representative bodies, such as the trade associations, the role of which was described in the blood glucose meter and standing frame cases, as well as charities which are involved with all kinds of stakeholders, such as Diabetes UK in the blood glucose meter case.

6.3. Performance Measurement and Performance Management

This section reports on the similarities and differences in performance measurement and performance management processes described by respondents across the four cases, in the following two sub-sections.

6.3.1. Performance Measurement

The previous chapter described performance measurement processes in each of the four cases, showing similarities between them, as well as a number of contrasts. The cross case findings matrix in Appendix S and Figure 22 later in the chapter show the performance measurement, as well as performance management processes and their influences. In all four cases a variety of performance measurement processes concentrating on a range of different types of performance measures were described by respondents. As in the previous chapter, this section describes processes that measured key aspects of performance (Griffin & Page 1996) and key themes identified empirically, following the analytic process of coding and developing matrices.

Financial Performance Measurement Processes

Cost of the products was measured by actors in all four cases, including all four suppliers, involving measures such as sales and profitability of the product line. The ECG monitor supplier was the only one who discussed developing an economic model of the performance of their product, studying cost savings the product could make for the customer by changing care pathways. Cost of the product was also measured by purchasing decision-makers from the NHS. Local level decision-makers described checking the cost of the product against a budget, however costs were also measured on the national level, including trying to ascertain maintenance or lifetime costs in the CT scanner and ECG monitor cases. In the blood glucose meter case performance measurement of the cost of strips was carried out on the national level by the PPD as part of cost cutting in the prescription reimbursement process, where the percentage reduction in strip cost became the key measure for negotiation with the supplier. Also on a national level, NHS Supply Chain and PASA Category Managers produced purchasing advice, guidance and document templates for performance measurement as part of the purchasing process, including guidance on measuring product costs (NHS PASA Procurement Guidance pp12-14, NHS PASA 2005 pp1-17), though they do not carry out this measurement themselves.

Technical Performance Measurement Processes

In each case the supplier measures technical aspects of performance of the product as part of developing and improving it such as alpha and beta site testing in the CT scanner case, though respondents in the ECG monitor case also emphasised that this was driven by the need for the product to meet regulatory standards. Also, the ECG monitor was submitted for a performance audit by an independent external organisation other than the Evaluation

Centre and the supplier carried out a clinical trial in a local Trust studying referral rates. The suppliers of the blood glucose meter and ECG monitor also arranged clinical trials for their products. In all cases the evaluation centres have measured the technical performance of the innovative products focussing on traditional laboratory measures such as accuracy or stability for example, though those involved in the blood glucose meter and multi-slice CT scanner cases are moving towards producing ‘buyer’s guide’ type outputs based on inclusion of more purchasing and economic performance measurement information. The evaluation of the standing frame also included some customer, but not financial, performance measurement. This evaluation contrasted with the others by measuring the performance of product features rather than the product, as part of a multiple-product evaluation. Although the products in all cases were innovative and had novel features, all except the ECG monitor had their performance measured at the same time as other competing products, either in a group evaluation or as part of a purchasing process.

Customer Performance Measurement Processes

In all cases, customers or users of the innovative products measured various aspects of the performance of the product for them as customers. The performance of all the products was also assessed by local level social exchange between the customer and supplier, where supplier representatives visited the customer to demonstrate the product, or arranged for clinicians and users to try using the product on a visit. In the case of the CT scanner, clinicians from the purchasing team visited examples of the scanner and competing products, and tried examples of the workstation brought to the Trust by the supplier. The performance measurement process involved a subjective evaluation of technical and consumer aspects of the performance of the CT scanner for them as customers, assessing how the product would perform for their particular clinical interests in the Trust. Individual actors would often become well known to each other and develop a long-term relationship. In the ECG monitor case, the GP interviewed stated that he had tried the product out on himself at the time of purchase. In all four cases, clinicians consulted colleagues about the performance of the product, though only in the CT scanner and ECG monitor did this involve going outside their own organisation. In the case of the blood glucose meter, DSNs additionally described gathering information about the performance of the product from industry and patient organisations, such as Diabetes UK. However in all cases communication between the supplier and customer occurred to exchange information about the performance of the product, this being a key way respondents discussed how they assess the performance of the product. A contrast was seen between the cases of the CT scanner and ECG monitor and the cases of the blood glucose meter and standing frame, the latter two involving clinicians assessing the appropriateness of the product with particular patients for their individual needs, in many different purchasing decisions. The former two cases involved clinicians measuring the performance for purchasing a product, which would then be used over a longer-period of time with a patient population.

All suppliers also assessed how their own products performed for customers, though the ways in which this was done varied. All gathered some kind of feedback from users and buyers, often informally and through their sales representatives. The supplier in the blood glucose meter case stood out as using many different methods, such as focus groups, a third party market research organisation and questionnaire samples to gather softer, quality of life aspects of consumer performance.

Actors Measuring Performance by Social and Information Exchange

Across all four cases, a key finding was that respondents described assessing or measuring the performance of the innovative products through social and information exchange between actors. Examples mentioned include clinicians calling or visiting colleagues, asking for their opinions on the products and social exchange between supplier sales representatives and clinicians who were prospective purchasers of the product.

Measuring Performance as Part of the Purchasing Process

Many of the most prominent examples of performance measurement described by respondents involved measuring performance during the purchasing process, with the aim of informing decision-making in purchasing. As described above, clinicians and other actors with a buying role would assess various aspects of the performance of the product to determine whether to purchase it or not, or possibly a rival product on the market, whether for a particular patient in the case of the blood glucose meter and standing frame, or for use with a variety of patients in the other two cases. Other performance measurement by the PPD, and pharmacy for example was also related to decision-making about whether the blood glucose meter strips should be available on prescription and therefore purchased by the NHS. Overall, much performance measurement occurred with the aim of informing decisions about purchasing and supply of the product, rather than ascertaining performance of the product once purchase or adoption had taken place as part of the broader implementation of the innovation.

Use of Both Objective and Subjective Measures

Across the variety of different aspects of performance measured, use of both hard objective measures can be seen, such as measurement of costs, conducting clinical trials and customer satisfaction surveys in various cases. However all cases showed softer, subjective performance measurement processes where users gathered information about the product and communicated with other actors, often in an informal way.

6.3.2. Performance Management

In addition to similarities and differences in performance measurement processes across the four cases, the previous chapter also shows similarities and differences in broader (Halachmi 2005, Globerson 1985, Radnor & McGuire 2004, Lebas 1995), or follow-up (Globerson 1985, Ellram 1995) performance management processes across the four cases. Again these are shown in the cross case matrix in Appendix S, Figure 22 and the code frequencies in Appendix T. In addition to these broader or follow-up performance management processes, the literature review suggested that performance management processes can be defined with respect to performance measurement processes as those that have an influence in performance (Bourne *et al.* 2005, Halachmi 2005) and these are also shown.

A variety of performance management processes were found across the four cases, and are discussed here in terms of the key concepts identified in the analysis, as in the previous chapter. A number are similar to all cases, involving the dissemination of output information from the performance measurement process, use of that information in purchasing decision-making and product innovation.

Dissemination of Information from Performance Measurement

Dissemination of information from performance measurement involved report production amongst other outputs, feedback to other actors and training. Evaluation centre respondents in all four cases described how output information from technical evaluations was used in producing reports and other outputs, however the nature of these reports and other outputs varies between cases. In all cases except the standing frame, data from the suppliers was compared with data obtained in the centre’s own performance measurement. All evaluation centres except that in the ECG monitor case have produced product comparison reports, comparing performance measurement data from the product in question with other competing products. These three centres also produced some creative outputs, such as short colour tables of key product features for buyers in the case of the blood glucose meter, searchable databases of product features in the case of the CT scanner and decision trees in the case of the standing frame. Evaluation Centre outputs are all available online for dissemination to interested stakeholders. Different processing of the evaluation information also occurs, all cases tabulating and compiling data in some form to give it greater meaning, however in the case of the CT scanner an overall image score was compiled, whereas in other cases no overall scoring was given. However only the evaluation centre in the ECG monitor case would give prescriptive advice about whether the product should be bought or not, others refusing to do so.

In each case supplier staff gathered and fed back to the wider organisation ideas, issues or problems with the product, ascertained through social and information exchange with customers or users. This was often an informal process, however the suppliers in some cases used more formal procedures, such as the ISO 9000 CAPA process in the ECG monitor case. In the ECG monitor case, the supplier gave a free product to the customer, in return for feedback on product performance.

Training was described as a process using performance measurement information, though in the ECG monitor case this was not a finding substantiated across more than one respondent. In all cases, supplier staff worked with clinician and patient users to ensure that they operated the product correctly, whether through formal training courses in the CT scanner and ECG monitor cases, offering help lines and training for DSNs in the blood glucose meter case, or advising the therapist and child when assessing the standing frame for the child’s needs.

Making the Purchasing Decision

A key use of performance measurement information discussed by many respondents in all four cases was in purchasing and supply decision-making by buying actors, a follow up performance management process. Despite a lack of formal purchasing decision-making processes, all four cases featured subjective discussion amongst members of the buy group as to the merits of the product to be purchased, whether this was the Hospital Trust purchasing team, or a DSN sitting down with a patient to discuss and make the decision whether the blood glucose meter or a competing product is the most appropriate for their particular needs. Only in the CT scanner case was a formal tender process used. A key feature of this process that was not found in other cases is the scoring and weighting of performance measurement data on each scanner, as part of the decision-making process about whether to purchase the CT scanner studied in the case or a competing product. This case was also the only one to involve formalised debriefing to the supplier following the purchasing decision and a dedicated period of acceptance testing when the purchased product is installed, to ensure performance is as described by the supplier in the tender.

Further to making the purchasing decision, performance measurement information was also used in broader parts of the purchasing and supply or adoption process. In two cases, performance measurement data was used to justify funding to purchase the innovative product, once the purchasing decision had been made. Clinicians and supplier staff in the standing frame case have compiled justification documents with details of the benefits of standing with the standing frame and clinical details about the individual child concerned. The ECG monitor supplier also stated how some GPs present data on the performance of the product to their PCTs when making a case for funding. The technical performance of the ECG monitor was also audited, involving checking of the supplier’s performance data, by an MHRA notified body as part of meeting standards for sale. In addition to purchasing decisions by clinicians in Trusts, the blood glucose meter case showed that benchmarking the strip performance against existing strips on the NHS drug tariff was a process influencing the decision to list the strip on the tariff, thereby making it available on prescription. Further, the PPD and BIVDA industry body representing suppliers were involved in negotiations over strip prices on the NHS drug tariff, following the PPD’s measurement of strip prices and costs of reimbursement. The prescription reimbursement process gave rise to another process only found in the blood glucose meter case, that of the supplier regularly having to declare to the customer the contents of the service package for consistency.

Other performance management processes by the supplier were also aimed at making sales of the products to the purchasing actors. Suppliers in all cases except the standing frame distributed product information through means such as seminars and journals, trying to gain recognition of their products amongst stakeholders in the market, in addition to standard marketing materials such as brochures. However the ECG monitor supplier was the only one with a process of a free 30-day trial of the product to allow clinicians to try using it before committing to make a purchase. The case also saw the supplier give the GP surgery customer a free product upgrade without being requested, a process that was also seen in the blood glucose meter case, though in the latter it was tied to a product recall and replacement issue.

Product Innovation

Another key performance management process that was described in all four cases concerned innovation. Suppliers in all cases discussed how feedback from customers or users influences product design and development. Respondents described specific examples where a certain product design change was made following feedback; the screen and scale changes made to the blood glucose meter, the battery life and automated connectivity checking introduced to the ECG monitor, software alterations and dose reduction over previous models of the CT scanner and availability of new split knee blocks on the standing frame. In the example of the blood glucose meter, the redesign was part of a process of product recall and replacement, triggered by other feedback processes of referral of a safety issue to the MHRA and issuing a device alert warning.

Further to the permanent innovative changes to the products just described, one-off individual changes were also described in two of the cases. The suppliers in the standing frame and CT scanner cases made technical changes to the product for the needs of particular customers or users who purchase the product. In the case of the standing frame, therapists gave examples of the supplier fitting an alternative head support and additional straps for particular children, following assessment of the frame with the therapist and child. The contents of the CT scanner package is tailored to the particular Trust that issued the tender. The supplier discussed a package of additional cardiac and virtual colonoscopy software, on two CT scanners and three workstations with the Trust where many respondents in the case worked.

6.4. Influences of Performance Measurement and Performance Management in Performance

This section takes a cross case view of the findings where respondents described or suggested the influence of performance measurement and performance management processes in influencing the performance of the innovative products. It begins by illustrating the key influences described by respondents in the four cases as explored in the previous chapter and discussing them, then continues by grouping the influences into overarching types.

6.4.1. Influences of Performance Measurement and Performance Management from the Individual Cases

Studying the effects matrices in the previous chapter that show the influences described by respondents in each case, a number of influences are observed to be similar across all the cases, while others were only discussed in a subset of the cases. In addition to an illustration of the influences on the conceptual framework (Figure 22), the influences described in the four cases are summarised in an effects matrix which can be found in Appendix U. As before, the influences are annotated according to the type of influence, with predecessor performance measurement and performance management processes and a researcher explanation of the influence at a generic level for all the cases where it occurred. The matrix also displays which influences occurred in which case. Table 31 summarises the effects matrix in Appendix U, showing types of influences and which cases they occurred in.

This section continues the pattern matching analytic approach by identifying which of the observed influences were repeated across the cases, aiming to improve the internal validity of the research by identifying literal replications (Yin 2003 pp116-120), aiding matching the empirical findings with the conceptual framework. As the processes often take a different form in each case, for example the way a purchasing decision is made, the roles and processes are described at a fairly high level. Where an influence is observed in particular subsets of cases, distinguishing features of those cases are discussed, developing theoretical explanations for the different outcomes. Possible rival explanations for the influences described are discussed.

Product is Purchased or Not

A strong influence of performance measurement and performance management processes that was described by many respondents in all four cases was that the product is purchased or not following measuring its performance, then a decision made to purchase it, or a competing product, or not to make a purchase at all on the basis of the information from performance measurement. Fourteen, thirteen, eight and eleven different respondents in the four cases in order described how the product is purchased or not following a purchasing decision where the buyer uses performance measurement information to make a decision.

Whether buy group decision makers were the purchasing team in a Hospital Trust in the CT scanner case, an individual GP in the ECG monitor case or individual clinicians making a decision with patients in the blood glucose meter and standing frame cases; the purchasing decision determined whether the product was bought or not. In purchasing decisions where the product is bought, money is exchanged in the supply relationship, with a beneficial influence in financial performance of the product for the supplier, when it is not bought there will be no benefit to the financial performance of the product. In all four cases, respondents from the supplier associated sales of the product with good financial performance for that product. Meanwhile respondents described how the NHS customer gains the benefit of using the best product for healthcare, whether that is the product in the case or a competing product that is more suitable for their needs.

Influence (Described by semi structured interview respondents.)	**Cases Where Found**				**Type of Influence**	**No. of Cases Where Role Observed** (out of 4)
	CT	**BGM**	**ECG**	**SF**		
Product is purchased or not	**Y**	**Y**	**Y**	**Y**	+/- F/C	4
Supplier shows concern over performance measurement	**Y**	**Y**	**Y**	**Y**	+/- * F	4
The best product for the needs of the user is purchased	**Y**	**Y**	**N**	**Y**	+ C	4
Used in acceptance testing	**Y**	**N**	**N**	**N**	+ T	1
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	**Y**	**Y**	**Y**	**Y**	+ T	4
Performance measurement information not used in the purchasing decision	**Y**	**Y**	**Y**	**Y**	None	4
Product can be purchased or not for short-term, cost based rather than broader reasons	**Y**	**Y**	**Y**	**Y**	- F/T/C	3
CE marking does not necessarily signify a product that performs to a sufficient standard	**N**	**Y**	**N**	**N**	- F/T/C	1
Used to reduce product cost	**N**	**Y**	**N**	**N**	+/- F	1
Product design improved	**Y**	**Y**	**Y**	**Y**	+ T	4
Feedback to the supplier is not used	**Y**	**N**	**Y**	**Y**	None	3
Useful for repairs	**Y**	**N**	**N**	**N**	+ T	1
Product meets needs of individual user as it has been customised with special features for the particular purchase	**N**	**N**	**N**	**Y**	+ C	1
Compliance with use of the product is needed	**N**	**Y**	**N**	**Y**	None	2
Training is necessary for patient to gain benefits of product use	**N**	**Y**	**N**	**Y**	+ C	2
Currently little evidence on the effectiveness of the healthcare procedure the product is part of	**N**	**Y**	**N**	**N**	None	1

Table 31. Summarised Influences of Performance Measurement and Performance Management Processes as Described by Respondents and Cross Case Patterns. (**KEY:** ‘Y’=Yes, influence found in case, ‘N’= No, influence not found in the case. ‘+’ is a beneficial influence, ‘-‘ is a non-beneficial influence. ‘F’ is an influence in Financial performance, ‘T’ is an influence in Technical performance and ‘C’ is an influence in Customer performance (After Griffin & Page 1996). ‘None’ means there is no influence on performance. ‘*’ denotes an influence inferred by researcher rather than specifically described by respondent).

Some of the cases showed how other customer actors in the supply networks also made decisions that influenced the purchasing decision assessed above, using underlying performance measurement and performance management processes. The NHS PPD approved the blood glucose meter strips for inclusion on the NHS drug tariff, enabling prescription reimbursement and the product to be bought on the NHS. The pharmacy also used a committee to decide whether to stock the blood glucose meter for sale in their branches. Although some patients buy their own blood glucose meter from the pharmacy, many are given the meter free at a clinic by a DSN and the strips are already available on prescription so the influence of the pharmacy committee decision making on performance may be less than that of the PPD, enabling it to be sold in the first place.

The performance management processes of making the purchasing decision followed up the performance measurement processes of gathering data for the purchasing decision in all the cases. Indeed the processes of assessing the performance of the product for a particular patient then making a purchasing decision, often occurred at the same meeting with the patient in the blood glucose meter and standing frame cases. Respondents also described broader performance management processes of processing the raw data once they had measured performance. Processes discussed included tabulation, statistical analysis, comparison between products and comparison against data from the supplier. Some were case specific, such as the economic modelling of the impact on care pathways in the ECG monitor case. In addition to processing the performance measurement data, broader processes of producing and disseminating reports and other outputs were discussed. The influence of the traditional evaluation reports was discussed by respondents in all four cases and some respondents described how they were useful in making purchasing decisions. Although some of these respondents were unsurprisingly from the evaluation centre and had an interest in saying so, others in the blood glucose meter case such as a DSN and the pharmacy respondent agreed.

The free thirty day ‘try before you buy’ offer from the ECG monitor supplier was described as encouraging GPs to buy the product, having an influence according to the supplier as less than 10% did not buy at the end of the period. Performance measurement data from the supplier was used in their marketing materials to present it as a diagnostic tool, the product being featured as a case in the HITF report for example (HITF 2004 p14). However the supplier would have been more successful to market the product as a speed of referral tool given the performance suggested by the information according to a respondent at NHS PASA, also suggesting the influence of performance measurement outputs. These are further examples of how performance measurement information used in follow up performance management processes have an influence on performance of the product. However other cases were not as explicit about the use of performance measurement information in marketing the product and sales.

Supplier Shows Concern Over Performance Measurement

In addition to the influence just discussed in whether the product was purchased or not, a code developed during the coding described suppliers showing concern over performance measurement, becoming interested or even competitive over the results.

The code was found across all four cases, and can be interpreted by the researcher to suggest that suppliers show concern over performance measurement because it has an influence on performance of the product, affecting sales. Although not an influence explicitly described by respondents, it reinforces the finding that performance measurement processes have an influence on performance of the product.

The Best Product for the Needs of the User is Purchased

Further to describing an influence of whether the product was bought or not, respondents in all but one case discussed how the best product for the needs of the particular user is purchased. In the CT scanner case respondents described how clinician assessments and the tender process aided buying the best scanner for the particular needs of the Trust, while clinician assessments and purchasing decisions made with the patient in the blood glucose meter and standing frame cases resulted in the best meter or frame for the patient being purchased. The ECG monitor case is an outlier here, as this influence did not occur, however this case may be deviant because there were no competing products for the ECG monitor in the GP setting so there is not a best product. This suggests that the case is deviant for a reason that does not lessen the strength of the finding suggested by the other three cases (Miles & Huberman 1984 pp237-238), at least for situations where there are competing products on the market.

Used in Acceptance Testing

In the CT scanner case, respondents described how performance measurement reports from the evaluation centre technical evaluation are used in acceptance testing, ensuring that the CT scanner performs as expected when it arrives following purchase. The technical performance of the scanner is checked against the description in the tender specification with reference to the evaluation centre report. If performance is satisfactory, the balance of payment is given to the supplier. In short, performance information is used in a checking process to ensure the technical performance of the CT scanner is as promised. Formal acceptance testing procedures were not described in the other three cases, however the processes that constitute the purchasing process vary from case to case as stated above and this acceptance testing process is found in the only case where a tender process occurs.

Supplier Ensures Product Performs to Their Specification and Regulations

Whereas only one case formally described acceptance testing, respondents in all four cases highlighted that supplier knowledge that the customer carries out performance measurement and performance management processes means that the supplier will ensure their product performs technically to the specifications in the way claimed and also meets regulations in the field. In describing this influence, respondents mainly referred to use of data from the technical evaluation by the Evaluation Centre and that the performance measurement of the product is checked against the claims made for it as part of making the purchasing decision.

Performance Measurement Information is Not Used in the Purchasing Decision

While a key finding repeated across all cases above was that performance measurement and performance management processes result in the product being bought or not, another key finding reported across all four cases was that information from performance measurement is sometimes not used in purchasing decision-making, so the information from performance measurement does not have an influence in whether the product is bought or not. In particular, it was stated that limited or no use was made of the technical evaluation outputs. The Evaluation Centre outputs were variously described as not prescriptive enough to be useful, not timely, expensive and difficult to access for use in purchasing decisions. Further, respondents described how many other things can influence a purchasing decision than information on the product, such as organisational factors. Similar to the lack of use of technical evaluation outputs, none of the buy group respondents in any of the cases described using the purchasing guidance and tools provided by NHS PASA and Supply Chain. The finding agrees with that above that the purchasing decision influences whether the product is bought or not, however it shows that performance measurement processes may or may not be used, suggesting two patterns, the first where the product is bought or not on the basis of information from performance measurement, the second where the product is bought or not regardless.

The Product Can be Purchased or Not for Short-term, Cost Based Rather than Broader Reasons

Another key finding describing the influence of processes in whether the product is bought or not is that, in all cases, the decision is often made for short-term reasons on the basis of information about cost performance, rather than made with a longer term view and on the basis of information of broader value than cost. Respondents suggested that this had a non-beneficial effect on the performance of the product, as low cost products are bought rather than innovative products with features that benefit healthcare. The NHS buys a product that may not perform as well as an alternative technically, from their point of view as a customer, or in terms of the lifetime costs of the product or treatment pathway it is part of. The supplier loses sales to lower cost products that are not innovative. This influence and finding reinforces the first, that performance measurement and performance management processes have an influence on whether the product is bought or not, however it suggests that that influence is non-beneficial where the information from performance measurement is too limited to financial performance.

CE Marking Does not Necessarily Signify a Product That Performs to a Sufficient Standard

Respondents in the blood glucose meter case only highlighted that product buyers often just look for a CE mark, described as a poor guide to product performance, before making a purchasing decision. They suggested that this could have a non-beneficial influence, as the product bought may not perform to a sufficient standard in terms of a variety of aspects of performance.

Used to Reduce Product Cost

The blood glucose meter case alone found that the processes are used to reduce cost of the product, in the example of the PPD negotiating a cut in strip prices with the supplier. This had an influence in the NHS buying the same strips that performed identically technically with the same customer support package, yet for a lower cost, improving financial performance of the product for them. However this had a non-beneficial effect on the financial performance of the product for the supplier, reducing their profit margin on the identical product. There was no evidence of negotiating cost reductions in the other three cases and the influence is similar to the last, where the product is purchased or not for cost-based, short term reasons, with the added twist that the NHS have not lost out in technical or customer performance of the product as it is a repurchase situation.

Product Design Improved

A strong pattern across all four cases was seen in the influence of the processes in improving the design of the product. Following the various actors assessing the performance of the products, feedback to the supplier occurs, who then make innovative changes to the product, with the outcome that the technical performance of the product is improved. Whether the feedback came from supplier representatives gathering information about the product, or via the MHRA device alert, in all cases the suppliers took proactive action to re-innovate features of their product. The ECG monitor supplier was the only one to discuss using a formal CAPA system, in which feedback from customers and users is stored in a database and issues are prioritised for action to address them. However in the other three cases, respondents stated that their sales and applications representatives who interact with customers and users on an individual level seek and gather the information in a less formal, subjective way, which is then fed back to the company as a whole.

Feedback to the Supplier is Not Used

In contrast to the finding in all four cases where performance measurement and feedback were used to improve the design and technical performance of the product, all but the blood glucose meter case found that feedback to the supplier is sometimes not used and that the information concerned does not have an influence on performance of the product as it is not used. This finding not only reinforces the above, that both performance measurement and performance management are necessary for an influence on performance, but also highlights that the performance management processes must involve proactive re-innovation, rather than the less proactive dissemination of information in feedback. It was not commented that feedback in the blood glucose meter case was not used, which corroborates with the finding above that it was used in re-designing the display and scale.

Useful for Repairs

Another influence with a beneficial effect on the technical performance of the product was observed in the CT scanner case alone. Respondents described how the technical evaluation enables the Trust to check the performance of the CT scanner against the expected during its operation, which helps make the case to the supplier to come and make repairs. The finding is not strong as it appears in only the one case, possibly as it is the case where the ongoing maintenance of the product by the supplier was most thoroughly described. However, it is similar to the influence of evaluation centre reports in acceptance testing of the CT scanner, having a beneficial influence on technical performance. In both findings, the performance management processes involve checking performance against the expected, rather than the subsequent purchasing decision or maintenance which actually changes the performance of the product.

Product Meets the Needs of the Individual User as it has been Customised with Special Features for the Particular Purchase

Innovation in the design of the products also occurs on a more immediate and local scale for the needs of a particular user as exemplified in the standing frame case, where therapists and supplier staff who work together to assess whether the standing frame is the most appropriate or not for the needs of a particular child have customised the product with different components in response to their assessment. The result is that the processes have improved the customer performance of the product. Although not represented in the findings at this level, there was some evidence that the CT scanner package offered by the supplier was also tailored to the needs of the particular Hospital Trust. Supplier respondents stated that the package will change from tender to tender. On the other hand, the blood glucose meter and ECG monitor are standard products and there was no process of changing their performance for particular customer's needs. These products are not customised, so the performance management process of customisation noted in the standing frame and CT scanner cases does not have an influence on their performance. This reinforces the finding that in cases where customisation occurs it has an influence on performance, in contrast to those control cases where it does not and there is no influence.

Compliance With Use of the Product is Needed

A finding in two of the four cases highlighted an issue regarding use of the product, namely that performance measurement and performance management processes may have no role in performance if the patient does not use the product. The blood glucose meter case highlighted an issue that the product was often not used by patients when instructed to do so by a DSN. The issue highlights that, whatever the performance of the blood glucose meter as a product and whatever performance measurement and management processes have occurred, it cannot perform for the consumer and play a part in their healthcare if it is not ultimately used. A similar point was made in the standing frame case. A contrast can be drawn with the CT scanner and ECG monitor cases where this finding did not occur. In these cases the products were used by the clinician who either conducted scans or fitted the patient with the ECG monitor, whereas the blood glucose meter and standing frame were for use by the patient themselves when independent of the clinician. Compliance, or use of the product by the patient can be considered a performance management process, as it follows performance measurement and indeed some other performance management processes such as the purchasing process. However it was not explicitly discussed by respondents as a performance management process, only when referring to the influences of the other various performance measurement and performance management processes. Again, the finding that the product must be used to perform for the customer suggests that it is the most proactive performance measurement and performance management processes that have an influence on performance.

Training is Necessary for the Patient to Gain Benefits of Product Use

In addition to finding that the product must be used for the processes to have an influence on performance, findings from the blood glucose meter and standing frame cases highlight that if customers are not just to use their products but to use them correctly and gain healthcare benefits, training is necessary. Training was described as improving the customer performance of the products by aiding customers to use them correctly. Training was also discussed in the CT scanner case, by three respondents and in the ECG monitor case, though only by one respondent; however the influence of training in these cases was not discussed, weakening the finding as the pattern is only matched over half the cases.

Currently Little Evidence on the Effectiveness of the Healthcare Procedure the Product is Part of

The blood glucose meter case highlighted an issue with the influence of performance measurement and performance management processes, that there is currently limited evidence on the effectiveness of blood glucose monitoring as a clinical activity, rather than the effectiveness, or performance of the particular blood glucose meter. This raises the issue that the processes may have no influence on the customer performance of the products for the NHS, whatever the performance of the particular meter. If blood glucose monitoring does not benefit the patient, then the meter will not, no matter how well the device performs. This lack of an influence was not described in the other three cases, perhaps highlighting that medicine is currently focussing more on the effectiveness of blood glucose monitoring as a discipline than on the other clinical activities.

Having discussed the influences found in the four cases, the next sub-section investigates how these influences may be grouped.

6.4.2. Grouping the Influences of Performance Measurement and Performance Management Processes

This sub-section generates meaning by grouping the influences into overarching types of influences that the performance measurement and performance management processes have, considering rival groupings based on the various types of influences (Miles & Huberman 1984 pp216-229). As assessed when describing the influences above, many are conceptually similar, suggesting that the number of influences can be refined, as follows.

The influence of the processes in whether the product is bought or not is found in all cases and is conceptually similar to a number of the other influences. It is reinforced by the implied influence that suppliers show concern about performance measurement, also found in all cases. Another strong influence found in all four cases that is conceptually similar is that the best product for the needs of the user is purchased. It refers to the beneficial customer performance the NHS gains from the product, bought following performance measurement and taking the purchasing decision. A further influence that is conceptually similar is that the supplier ensures the product meets their claims and regulations in terms of technical performance, as they know the product will be tested before purchase. This finding refers to another way in which performance measurement and management processes have an influence on the technical performance of the product the customer buys. Also, the influence that performance measurement information is used in acceptance testing can be grouped with the influence of whether the product is bought or not. Although only described in the CT scanner case, the case with the formal tender process, the influence describes the outcome of part of the broader decision to purchase the CT scanner or not, as payment is only made when the acceptance testing has been completed. The non-beneficial influence discussed in all cases where the product is bought for short term cost based reasons and the lack of an influence where performance measurement information is not used in the purchasing decision also refer to the purchasing decision, but are left separate as they represent non-beneficial or no influences respectively. The weaker finding of buyers only using a CE mark to buy the product also refers to a non-beneficial influence arising through using limited information in making the purchasing decision so could be grouped with the non-beneficial influence about buying the product for short-term cost based reasons, though is left separate here as it refers to measuring technical rather than financial performance. Described only in the blood glucose meter case, the influence of processes in reducing cost of the product also involves the outcomes of performance measurement and the decision to purchase the product. Although similar to the influence where the product was bought on cost, this influence is more similar conceptually to whether the product was bought or not, as the product remained the same in technical terms as well as in the way it performed for the customer, with a beneficial influence for the customer. Overall, these conceptually similar influences suggest that there is a strong finding of one influence in whether the product is bought or not.

The influence of performance measurement and performance management processes in improving the product design is also conceptually broad enough to cover some of the less strong findings. For example, that the product meets the needs of the customer following customisation is also an example of improving the product design by making innovative changes to the design of the product.

Meanwhile, some of the different types of influences reinforce the same conceptual finding. For example, although findings that information from performance measurement processes such as the technical evaluation both does and does not have an influence in purchasing decision-making is conflicting, it reinforces the concept that performance measurement has an influence when it is used and has no influence when it is not used. Another example is that of feedback being one of the performance management processes with an influence on improving product design with a beneficial influence, however the finding that feedback is often not used and has no influence reinforces the influence of feedback on performance. The influences describing the importance of compliance with use of the product and training for correct use were found in the same two cases, suggesting that these influences occurred where the patient used the product for themselves, rather than a clinician, a distinguishing feature of those two cases. Both influences refer to the use of the product to ensure it performs for the customer.

The rows in Table 31 can be grouped according to the attributes in the column that shows the type of influence. Table 32 shows the influences grouped according to their influence in financial, technical or customer performance of the product. Where influences had no influence on performance, they are grouped according to the type of performance they could have influenced, for example feedback to the supplier was discussed in terms of the influence it could have on technical performance.

The table demonstrates a cluster of processes with an influence on financial performance of the product, involving making the purchasing decision on the basis of information from performance measurement. However performance measurement information is not always used in making the purchasing decision. Another cluster of influences are those on technical performance of the product, including improvement of the product design, and that the supplier ensures the product performs to specifications and regulations. The weaker findings of 'used in acceptance testing' and 'useful for repairs' have an influence on technical performance, while one case highlighted that performance measurement is not always a sign of the technical performance of the product. Influences that cluster as they refer to the customer performance of the product include the best product for the needs of the user being purchased, that use of the product by the patient, training in use is needed and in some cases that the customised product meets the needs of the user. The lack of evidence for the clinical activities described in one case highlights how processes may not have an influence on the performance of the product for the customer.

Influence (Described by semi structured interview respondents.)	**Type of Influence**	**No. of Cases Where Influence Observed** (out of 4)
Influence on Financial Performance		
Supplier shows concern over performance measurement	F	4
Used to reduce product cost	F	1
Performance measurement information not used in the purchasing decision	None	4
Influence on Technical Performance		
Product design improved	T	4
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	T	4
Used in acceptance testing	T	1
Useful for repairs	T	1
Feedback to the supplier is not used	None	3
Influence on Customer Performance		
The best product for the needs of the user is purchased	C	4
Training is necessary for patient to gain benefits of product use	C	2
Product meets needs of individual user as it has been customised with special features for the particular purchase	C	1
Compliance with use of the product is needed	None	2
Currently little evidence on the effectiveness of the healthcare procedure the product is part of	None	1
Influence on Financial & Customer Performance		
Product is purchased or not	F/C	4
Influence on Financial, Technical & Customer Performance		
Product can be purchased or not for short-term, cost based rather than broader reasons	F/T/C	3
CE marking does not necessarily signify a product that performs to a sufficient standard	F/T/C	1

Table 32. Summarised Influences of Performance Measurement and Performance Management Processes, Grouped According to Type of Performance in Which They Have an Influence. (**KEY:** 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

However the influences do not all group clearly by type of performance influenced. Whether the product is purchased or not has an influence on both financial and customer performance for supplier and customer actors respectively. Purchasing the product for short-term, cost based reasons can hinder financial performance for an innovative product supplier and mean that the NHS misses out on products that perform better technically, for them as a customer and longer-term financially.

Given that the influences do not all group neatly by the type of performance they have an influence on, or according for example to some of the performance management processes involved, other criteria can be used for clustering. Table 33 shows the influences grouped according to whether they have an influence on performance or have no influence on performance. Further, those with an influence on performance are grouped according to whether they have a beneficial or non-beneficial influence on performance.

Table 33 highlights that the performance measurement and performance management processes which have an influence on performance involve using information from performance measurement in performance management processes such as making a purchasing decision and innovation. Additionally, performance management processes of disseminating performance measurement information, including through feedback and checking performance against expected levels are involved. Most of the influences were described as beneficial, where sales had been made, the product technically improved or the customer receiving the product that performs best from their point of view. Another example was the influence of training in aiding users to operate the product correctly, improving its customer performance for them. However some influences had both a beneficial and non-beneficial effect on performance, illustrating that if particular processes had a certain outcome performance would be improved for both customer and supplier actors, whereas if the processes had a different outcome there would be a detrimental influence on performance of the product for the supplier, while there was still a beneficial influence on performance for the customer who had chosen the best product for their needs. The influence was beneficial or non-beneficial according to the actor concerned. If the decision was made to purchase the product for example, it performed for both the customer and supplier, however if that product was not purchased, the supplier lost sales as the process had a non-beneficial influence, though the processes still had a beneficial influence on performance for the NHS, buying the best product for healthcare.

Influence (Described by semi structured interview respondents.)	**Type of Influence**	**No. of Cases Where Influence Observed** (out of 4)
Beneficial or Non-beneficial Influences		
Supplier shows concern over performance measurement	+/- *	4
Product is purchased or not	+/-	4
Used to reduce product cost	+/-	1
Beneficial Influences		
Product design improved	+	4
The best product for the needs of the user is purchased	+	4
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not	+	4
Used in acceptance testing	+	1
Useful for repairs	+	1
Product meets needs of individual user as it has been customised with special features for the particular purchase	+	1
Training is necessary for patient to gain benefits of product use	+	2
Non-beneficial Influences		
Product can be purchased or not for short-term, cost based rather than broader reasons	-	3
CE marking does not necessarily signify a product that performs to a sufficient standard	-	1
No Influence		
Performance measurement information not used in the purchasing decision	None	4
Feedback to the supplier is not used	None	3
Compliance with use of the product is needed	None	2
Currently little evidence on the effectiveness of the healthcare procedure the product is part of	None	1

Table 33. Summarised Influence of Performance Measurement and Performance Management Processes, Grouped According to Whether They Have a Beneficial, Non-beneficial or No Influence. (**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

In addition to the possible beneficial or non-beneficial influences just described, solely non-beneficial influences were found across most of the cases where a decision was made to purchase the product on the basis of cost information with a short term view, and in the blood glucose meter case where the product was bought solely on the basis of a CE mark. Evidence of broader performance of the product was not used in the decisions described, with the influence in the first example that the supplier of the innovative product lost sales to low cost rival products, while the customer lost the technical and customer benefits by buying a product that was simply cheap. Very little information from performance measurement was used in making the purchasing decision, only that concerning cost. In the CE mark example only limited technical information was used in making the purchasing decision.

Finally a set of influences can be grouped where respondents described how the processes do not have an influence on performance. Strong findings across all four cases described how performance measurement information is not used in purchasing decisions and how feedback to the supplier is not used to improve the product. These findings describe that where performance measurement has occurred, but no broader or follow up performance management processes have occurred, there is no influence on performance. Further, the finding that the product must actually be used to perform for the customer reinforces that proactive, performance management processes are required if there is to be an influence on performance. There is also limited evidence from one case that both the performance measurement and performance management processes may have no influence on performance at all where there is little evidence of the effectiveness of the clinical activity that the product is involved in.

Overall, clustering the various influences as to whether they were beneficial, non-beneficial or had no influence on performance highlights some general findings about the influences of the processes. Where a beneficial or non-beneficial influence occurred, both performance measurement and performance management processes were found, with the latter focussing on proactive decisions about purchasing and supply, or innovation of the product. The influence may only be beneficial for one of the organisations involved however. A non-beneficial influence occurred when the decision was made to purchase the product using only limited information, often about cost, highlighting that little or limited performance measurement that is followed by performance management may have a non-beneficial influence on performance. Finally, the data highlights that where performance measurement occurs, but not performance management, no influence on performance of the product occurred. However some of the less proactive performance management processes, such as dissemination of performance measurement information and feedback to the supplier are also found, raising a question as to their influence on performance when they are also found to have a beneficial influence with the more proactive processes described above. For example, dissemination occurred before the decision was made to purchase the product, however it also occurred where the performance measurement information was not used by the customer. This suggests that the less proactive performance management processes such as dissemination and feedback are more conceptually similar to performance measurement processes as they do not have an influence on performance unless supplemented by a more proactive purchasing and supply, or innovation process. The influence of these processes is discussed more thoroughly in the following discussion chapter. Findings from this sub-section are summarised in Table 34, showing the overall findings of the influences of performance measurement and performance management processes. The table shows the stronger findings that are repeated across more than one case in Table 31 in bold and also groups the findings that are conceptually similar, as described above.

6.5. Summary

This chapter has reported on the findings of the four case studies from a cross-case perspective, focussing on cross case patterns of their similarities and differences. Figure 22 summarises the cross case findings by illustrating them on the conceptual framework. The products studied in each case were all identified as being innovative, though the level of implementation and length of time varied, as did the care areas and cost.

There were also similarities in the performance measurement and performance management processes discussed by respondents in each case. In all cases, actors variously measured financial, technical and customer aspects of the performance of the product, with all cases showing information and social exchanges between customer and supplier organisations as a way of gathering information or evidence about the performance of the product. Processes varied from quantitative laboratory measurements to subjective assessments by users and stakeholders. In all cases performance was measured as part of the purchasing and supply process.

Some key performance management processes were found across all the cases, such as dissemination of information from performance measurement, using it in making a decision to purchase the product or not and processes involved with identifying and rectifying product faults. Within this broad picture however, some processes were only found in some or even one of the cases, such as assessing the performance of a product for inclusion on the NHS drug tariff, for example. The particular nature of processes also varied in the different cases. For example, purchasing decision-making included tender processes involving a purchasing team, scoring, weighting and subjective discussion, as well as individual clinicians making subjective decisions with patients about the product to use. In addition to these proactive performance management processes, dissemination of information, checking of performance, feedback, training and product customisation were also described by respondents in some, if not all of the cases. Respondents also emphasised the importance of patients complying with use of the product, a further performance management process.

Influence Type	Performance Measurement Processes	Performance Management Processes	Influences Described by Respondent (Stronger findings repeated across >1 case shown in bold)	Strength of Evidence for Influence
Beneficial Influence on Performance (+)	Measuring financial, technical, customer performance of the product. Communication and social exchange between actors.	Information dissemination, purchasing. Feedback to supplier, product re-innovation.	• **Product is purchased or not**. (*The best product for the needs of the user is purchased, Supplier shows concern over performance measurement, Used in acceptance testing, Used to reduce product cost, Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not)*	Pattern observed across all four cases. Confirmed by evidence of strong patterns across respondents within each case, with many uses of the 'Buyers Use' code (14,13,8,11 respondents per case). Many influences described by respondents refer to influences with the same concept of the product being purchased or not following measurement, dissemination and purchasing decision making (influences shown in brackets). A comparison with the finding that performance measurement information may also not be used, with no influence or that limited performance measurement information may be used with a non-beneficial influence, reinforces this finding.
			• **Product design improved**. *(Product meets needs of individual user as it has been customised with special features for the particular purchase)*	Pattern observed across all four cases. Confirmed by evidence of strong patterns across respondents within each case, with many uses of the 'Re-designed Product Improved' and 'Tailored Appropriate Codes' (6,4,5,5 respondents per case for both codes). A comparison with the finding that feedback may also not be used, with no influence, reinforces this finding.
			• **Training is necessary for patient to gain benefits of product use**	Pattern observed across two of four cases, those where product was used by patient, not clinician, suggesting pattern should only be found in those two cases. The finding shows that a beneficial influence occurs when information from performance measurement is followed up by proactive performance management processes.
			• Useful for repairs	Pattern only observed in one case, a weaker finding. Differentiated from 'Product design improved' as it refers to maintenance of a particular example rather than innovation. Although weaker, the finding still shows that a beneficial influence occurs when information from performance measurement is followed up by proactive performance management processes. *Continued overleaf*

Non-beneficial Influence on Performance (-)	Measuring financial performance of the product.	Information dissemination, purchasing.	• **Product can be purchased or not for short-term, cost based rather than broader reasons.**	Pattern observed across all four cases. A comparison with the finding that performance measurement information may also not be used, with no influence or that performance measurement information is used with a beneficial influence, reinforces this finding of a non-beneficial influence where limited information from performance measurement is used.
			• **Product is purchased or not**. (*The best product for the needs of the user is purchased, Supplier shows concern over performance measurement, Used in acceptance testing, Used to reduce product cost, Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not)*	As described in the beneficial influence of whether the product is purchased or not (above), the finding highlights that this influence on performance may be perceived as beneficial by one stakeholder organisation and as non-beneficial by another.
			• CE marking does not necessarily signify a product that performs to a sufficient standard	Pattern only observed in one case, a weaker finding. A comparison with the finding that performance measurement information may also not be used, with no influence or that performance measurement information is used with a beneficial influence, reinforces this finding of a non-beneficial influence where limited information from performance measurement is used.
No Influence on Performance (None)	Measuring financial, technical, customer performance of the product. Communication and social exchange between actors.	Information dissemination. Purchasing.	• **Performance measurement information not used in the purchasing decision**.	Pattern observed across all four cases. A comparison with the finding that performance measurement information is used, with a beneficial influence or that limited performance measurement information may be used with a non-beneficial influence, reinforces this finding.
			• **Feedback to the supplier is not used**.	Pattern observed across three of four cases. A comparison with the finding that feedback is also used to improve the design of the product, with a beneficial influence, reinforces this finding.
			• **Compliance with use of the product is needed**	Pattern observed across two of four cases, those where product was used by patient, not clinician, suggesting pattern should only be found in those two cases. The finding shows that no influence occurs when information from performance measurement is not followed up by proactive performance management processes. *Continued overleaf*

			• Currently little evidence on the effectiveness of the healthcare procedure the product is part of	Pattern only observed in one case. This weak finding suggests that no influence occurs when information from performance measurement and follow up performance management are not used in an effective clinical process.

Table 34. Summary of Overall Findings about the Influences of Performance Measurement and Performance Management Processes

Respondents in all cases described the influence of performance measurement and management processes in performance. The case findings were consistent in describing various influences of the processes in whether the product was bought or not, in improving the design of the product or not and those cases where the patient uses the product themselves highlighted the influence of use of the product once bought. Processes were described as variously having an influence on financial, technical or customer performance, as well as that the influence could be beneficial or non-beneficial, also that there might not be an influence in some examples. Influences were grouped according to conceptual similarity, then various alternative clusters according to the types of performance were illustrated. The data from respondents suggested that, with different occurrences of performance measurement and performance management processes, there may be a beneficial influence on performance, the opposite, or no influence on performance at all. The findings about the performance measurement and performance management processes and their various influences on performance are used in the rest of the thesis to analyse how performance measurement and performance management can be differentiated, in the light of the suggestions made in the existing literature.

Having reported the findings from across four cases, the next chapter of the thesis continues by discussing the findings in the context of the existing body of knowledge discovered in the literature review.

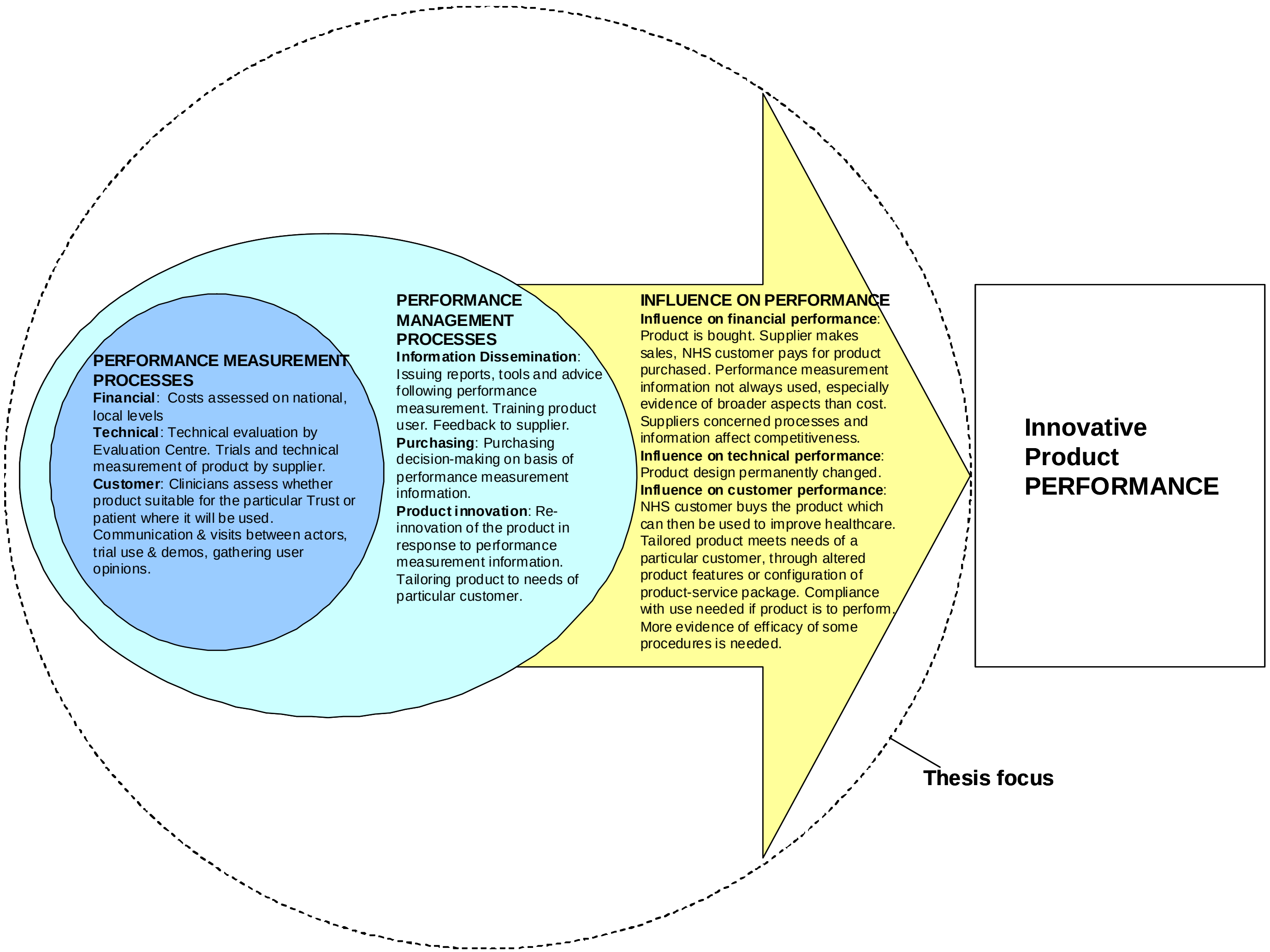

Figure 22. Conceptual Framework Illustrated With Cross-Case Finding

Part Three: Discussions and Conclusions

CHAPTER SEVEN: DISCUSSION OF FINDINGS

7.1. Introduction

This chapter discusses the empirical findings reported in the previous two chapters, in the context of the existing bodies of knowledge analysed in the earlier literature review chapters.

The structure of the chapter is based upon the key concepts under investigation in the conceptual framework, which was based on the literature. The discussion starts by focussing upon the performance measurement processes discovered in the exploratory empirical work and how they relate to the current knowledge base in the literature. The performance management processes found in the empirical work are then examined in the same way. The discussion focuses on performance measurement then performance management as this reflects existing frameworks used in the conceptualisation (eg Lebas 1995) and a key conceptual issue identified in the literature (Radnor & McGuire 2004). The chapter then concentrates on discussing the influences of the performance measurement and performance management processes that were discovered empirically in the light of the existing literature, followed by an investigation of the conceptual differences between performance measurement processes and performance management processes. From cues in the literature, this discussion investigates whether the concepts can be differentiated by the latter being broader (Halachmi 2005, Lebas 1995), or by the latter involving taking action on measures where a performance change occurs (Bourne *et al.* 2005, Halachmi 2005). Having drawn some conceptual lessons, discussion then returns to the conceptual framework, which is examined, revised in terms of the lessons from viewing the empirical findings in the context of existing work and used in creating a graphical display of concepts from the findings. As part of this discursive section, the key concept of performance reporting is identified.

A summary is presented, before the next chapter returns to reflect on the research questions in the light of the discussion in this chapter.

7.2. Performance Measurement Processes

The empirical work identified a variety of performance measurement processes that are found in the literature, as well as a number of additional processes. Given the wide variety of processes discovered in the empirical work, the section is structured around the key aspects of performance measured, after Griffin and Page (1996) as described in the conceptualisation chapter. It then continues to discuss some key exploratory observations about the processes from the empirical work and findings chapters, that many processes involved communication between actors, occurred before making a purchasing and supply decision and were informal and subjective, as well as formal and objective.

7.2.1. Financial Performance Measurement Processes

The performance literature concentrated on performance measurement and selection and implementation of measures in particular (Neely 1997), portraying different types of measures. Many of these different types of measure were found in the empirical data, where respondents described assessing not only physical aspects of the device, but also how the device performed financially and for the users concerned. Actors in all cases such as the suppliers and the NHS on a national level measured the financial performance of their products, focusing on sales, market share and internal accounting measures (Johnson & Kaplan 1987 pp253-262). In the innovation literature, Tidd *et al.* (2005 pp561-569) discussed measuring sales, profits and market share with respect to specific innovative products. The NHS as customer focussed on the cost of the product whether at the point of initial purchase or over the product lifetime. The more complex economic modelling carried out regarding changes to the care pathway seen in the ECG monitor case is reminiscent of the literature which discusses the costs and benefits of particular treatment interventions, for example (Thompson & Duintjer Tebbens 2006).

7.2.2. Technical Performance Measurement Processes

The literature advocates measuring broader, operational aspects of performance as well as using traditional financial performance measures (Ittner & Larcker 1998a, 1998b, Kaplan & Norton 1992, Bull 2007), a concept that was in evidence in all of the cases. Both supplier and customer actors measure technical parameters of the design and function of the product. This is reflected in two parts of the literature. Firstly the literature discusses quality as a performance objective, with Hayes & Wheelwright (1984 pp361-371) referring to defect prevention and awareness or monitoring. While they refer to an operational production process, the role of the evaluation centres was described as one of verification of supplier claims about the performance of their product. Suppliers also used technical performance measurement towards meeting regulatory standards. On a broader level, Slack *et al.* (2007 pp39-54) also refer to quality, or the ability to be able to do things right, suggesting the evaluation centres are measuring the technical quality of the products. Secondly, the literature describes performance measures for innovation (Tidd *et al.* 2005 pp561-569), which is oriented towards the firm producing the product and describes aspects such as literature publications in the particular technical field or application for the product. These specialist publications were drawn on by the evaluation centres in the process of measuring the technical performance of a product, for example in the ECG monitor case (Gamlyn *et al.* 1999). The literature also describes some of the specific tools used by individual clinicians to measure product performance, such as the Waterlow Scale as used by therapists in the standing frame case (Pancorbo-Hidalgo *et al.* 2006). Chiesa *et al.* (1996) also focus on measuring technical performance from the supplier's point of view. Some suppliers also discussed carrying out clinical trials to measure the performance of their product, as described in the evidence-based medicine literature (Belsey & Snell 2003 pp1-6).

7.2.3. Customer Performance Measurement Processes

Actors in the cases also measured the way the products performed for the customer, again reflecting the literature concept of measuring broader aspects of performance than those which are financial. Supplier actors in the cases were keen to understand how their product performed from the point of view of the customer, with customer testing frequently being an element of implementing an innovation (Tidd *et al.* 2005 pp393-394). The blood glucose meter supplier for example provided particularly diverse examples of measuring customer performance, conducting market research reminiscent of the service quality literature (Parasuraman *et al.* 1988) and also measuring softer, quality of life performance of the type described by Skevington (1999). Further customer performance measurement occurred as part of the purchasing process, described below.

7.2.4. Actors Measuring Performance by Social and Information Exchange

Individual actors in the relationship between customer and supplier were involved in many informal performance measurement processes. Interactions occurred between individuals from the suppliers, such as sales representatives or product specialists and individuals from the customer at the local level such as clinician decision makers. Visits were arranged and exchanged, with opportunities to see and trial the product. These are represented in the interaction model as short-term episodes in which information and social exchange occur and even the exchange of products, though not on a sale basis (IMP Group 1982). Social exchange is also described as occurring to gather information (Uzzi 1997). Reviewing the finding in the light of the literature suggests that social and information exchange to measure performance could actually be considered as a performance management process, as it is broader than the fundamental process of performance measurement (Lebas 1995) as described by Farbey *et al.* (1993 pp75-94). In other words, they are used to gain information that has already been measured by another actor. The discursive sections in the latter part of this chapter will assess whether social and informational exchange is a performance measurement or a performance management process, towards the end of refining the conceptual model. Social and informational exchange is discussed further in the next section on measuring performance as part of the purchasing process.

7.2.5. Measuring Performance as Part of the Purchasing Process

Many of the performance measurement processes occurred as part of a purchasing process, to which the purchasing and supply management literature provides some background. Performance measurement processes in purchasing are described by Webster and Wind (1972 pp28-37,89-106). As part of their general model of organisational decision processes, they describe how organisations evaluate alternative buying actions, before eventually selecting a supplier in a purchasing decision. At the fundamental level they describe the process as one of: *"…comparing the characteristics of the available alternatives against the criteria established when specifications and schedules were set."* (Webster & Wind 1972 p32). This implies that performance measurement occurs in a formal tender process as in the CT scanner case.

A less formal side to the purchasing decision-making process is seen in Webster and Wind's discussion of the buying behaviour of individuals in the buy group, indeed they comment that all organisational buying behaviour is actually individual buying behaviour. As part of this model they refer to cognition, described as a process of receiving and interpreting information from the environment. Cognition is followed by decision models. The overall model of buying behaviour describes the less formal process by which many of the individual clinician decision makers, such as DSNs, therapists, GPs or the clinician members of the purchasing team in the CT Scanner case, gather and store information from the environment on the performance of the innovative products, for use in a purchasing decision. As above, Uzzi (1997), Nohria (1992) and Granovetter (1973, 1985) all highlighted the role of social exchange in weak ties between organisations which are used to gather information from performance measurement. Similarly, Zaltman *et al.* (1973 pp60-66) refers to knowledge and awareness by potential adopters of an innovation, who then go on to form an attitude towards the innovation before a decision is made to buy or implement the innovation or not. These less formal processes are described further in behavioural literature from fields such as psychology, where concepts such as reward are discussed. Key research in the area studies how different types of reward are processed over different timescales and how this influences the behaviour of individuals, such as purchasing decision makers (Cohen & Blum 2002).

The evidencing literature has also focussed on decision-making, with regards to medical (Sackett *et al.* 1996), public policy (Muir Gray 2004a pp11-18, 65-100) or management (Pfeffer & Sutton 2006) decisions. The purchasing decisions made in the cases could be considered a management decision in the light of Pfeffer and Sutton (*ibid.*), however those made by individual clinicians are also decisions about medical treatments and techniques, as discussed by Sackett *et al.* (*ibid.*). In both fields the evidence-based literature describes how the best available information from within and outside the organisation must be gathered, information about the performance of the product. The different types of evidence discussed in the various evidence-based fields also emphasise the breadth of types of evidence, or performance measures that can be used. Indeed, the findings highlighted how actors gather information from other organisations, make assessments on the basis of their own experience or internal evidence and use a wide variety of types of evidence. This is not to say that the approaches observed were all evidence-based as defined by the literature, but that many of the performance measurement processes identified empirically are reflected in the emerging literature stream.

7.2.6. Use of Both Objective and Subjective Measures

A look at the performance measurement processes identified in the empirical work, particularly those involved as part of the purchasing process, shows that many were not formal, explicit processes but softer and more subjective. The literature goes some way to explaining this in the different views of measures and measurement it contains. For example the technical measures used by the evaluation centre were mostly hard, objective and carried out from a natural sciences viewpoint. On the other hand, many of the softer measures in the cases at the point of purchase, such as clinicians determining the most appropriate product for a particular patient were softer, qualitative measures of intangibles, being carried out from a social sciences viewpoint. The different approaches to measurement reflect the contrast between Chandlerian objective planning and control views (Chandler 1977 pp484-502) and Mintzbergian view (Mintzberg 1996) which emphasises softer aspects.

To summarise, Table 35 shows observations about performance measurement as described by respondents in the case studies, interpreted in the light of the existing literature where possible. The next section then continues the chapter by describing the performance management processes observed in the cases, in the context of the existing literature.

Performance Measurement Process From Cases	**View of the Existing Literature**	**Empirical Finding in Context of Existing Literature**
Performance Measurement Processes		
Measurement of financial performance of product; sales, market share, internal accounting measures. Cost of purchase and over lifetime, effects on care pathway.	• Financial performance measures have long history (Ridgway 1956). • Management accounting focuses on financial measures (Johnson & Kaplan 1987 pp253-262). • Cost-benefit modelling (eg Thompson & Duintjer Tebbens 2006).	As suggested by literature, measurement of the financial performance of products occurred.
Measurement of technical performance of product; technical evaluation by customers, supplier measures technical performance during innovation process.	• Hayes & Wheelwright (1984 pp361-371) defect prevention and awareness or monitoring. • Slack *et al.* (2007 pp39-54) refer to quality as performance objective. • Tidd *et al.* (2005 pp561-569) and Chiesa *et al.* (1996) measure the performance of innovation. • Belsey & Snell (2003 pp1-6) describe medical evidence.	Actors measure broader aspects of product performance, as suggested in the literature. Respondents measured technical performance for their need, reminiscent of measuring quality and the evidence based medicine.
Measurement of customer performance of product; customer assesses performance of product for their needs.	• Testing customer performance of product in product implementation (Tidd *et al.* 2005 pp393-394). • Measuring quality of life aspects of performance (Skevington 1999).	Actors measure broader aspects of performance, as in the literature. Actors measured performance of the product for customer needs.
Additional Observations on the Performance Measurement Processes		
Actors assess product performance by communicating and making visits	• Social, information and product exchange occurs (IMP Group 1982). • Role of social ties to gain information (Uzzi 1997, Nohria 1992 & Granovetter 1973, 1985).	Findings highlighted exchange of information between actors in literature as a way of measuring performance.
Measuring performance as part of the purchasing process; by buy group members	• Organisations evaluate alternative buying actions in decision processes. Individual buying behaviour involves cognition, decision-making. Individuals measure performance. (Webster & Wind 1972 pp28-37,89-106). • Behavioural aspect to assessing rewards (Cohen & Blum 2002).	Performance is measured as part of the purchasing process. Returning to the literature confirms product information is gathered as part of purchasing process.
Performance measurement processes focus on both harder, objective and softer, more subjective measures	• Views on measurement reflect either objective planning and control approaches (Chandler 1977 pp484-502), or softer aspects (Mintzberg 1996).	Empirical findings emphasise the qualitative, subjective nature of many processes that have received less emphasis in literature.

Table 35. Summary of Observations About Performance Measurement Processes from the Cases Interpreted with the Literature.

7.3. Performance Management Processes

As in the previous section, the variety of performance management processes that were observed in the empirical work are discussed in the light of the performance, innovation and purchasing and supply management literatures. The processes were identified empirically in the light of the existing literature as being planning and control processes that are broader than, or follow up performance measurement (Halachmi 2005, Lebas 1995). They are discussed broadly in terms of key themes identified empirically in the analysis and also discussed in the literature, which are dissemination of information from performance measurement, purchasing and supply decision making or re-innovation of the product.

7.3.1. Dissemination of Information from Performance Measurement

Following the performance measurement processes described above, the cases displayed a follow up process where the information produced was processed and disseminated to other actors or organisations. Similarly, actors shared information on the performance of the product by offering training and giving feedback to other actors or organisations.

As discussed above, the literature describes informational exchange between customer and supplier (IMP Group 1982), including the customer gathering information about the performance of the product from the supplier, or the supplier giving the customer information about the performance of the product. Social exchange also occurred with a similar purpose of disseminating performance measurement information, for actors to gather information about the performance of the product. Indeed social and information exchange can be considered a performance management process, as it involves disseminating information from performance measurement, a broader process (Lebas 1995). Further, the evidence-based literature advocates building a range of evidence from both inside and outside the organisation in a format upon which to make an informed decision. This process inherently involves the transfer of information between organisations and the creation of databases, for example, to store the information (Bambra 2005). Processes of data analysis, tabulation and comparison are widespread in the literature. The research methods literature as a whole describes processes and protocols for data analysis in various scientific and social scientific fields, underlying many of the processes carried out by the evaluation centres. Also, the more specific management literatures drawn upon in this study include tools for analysing performance measurement data by collating, tabulating and displaying it, for example the Balanced Score Card (BSC) (Kaplan & Norton 1992), though use of the BSC was not discussed by any of the respondents. A theme in the literature on performance measurement as a whole advises how information from measures should be displayed. For example, discussion of performance measurement in the literature focuses on appropriate selection and implementation of measures (Neely 1997), the latter including recommendations that measures should for example provide information rather than raw data (Fortuin 1988) and ensure visual impact (Lea & Parker 1989). The latter is reflected in the improved outputs for the end user developed by the Evaluation Centre in the blood glucose meter case where a shortened colour table buyer guide was introduced (Device Evaluation Service 2005). The outputs of the Evaluation Centre evaluations were also disseminated using the internet, including in online tools and databases. The literature describes the use of tools to manage performance following performance measurement (Hume & Wright 2006). Further to these processes of disseminating information from performance measurement, only one of the evaluation centres in the four cases was prepared to offer prescriptive advice on the basis of their evaluation as to whether the product should be bought or not. In this vein, Webster and Wind (1972 pp28-37) refer to members in the buy group with an influencing role, such as the evaluation centre in question, upon the decision-makers, such as the GPs in the ECG monitor case. The NHS Supply Chain or PASA staff issues purchasing advice to buyers at the local level. This was another form of influencing within the buy group, again involving informational exchange between customer and supplier actors.

Feedback was another follow up process to performance measurement that is also found in the literature. Many of the models of innovation discussed in the literature review feature a feedback loop, by which information from the latter stages of the innovation process, those that often involve customer actors is fed back to the earlier stages. Zaltman (1973 pp71-77) describes feedback as part of the innovation process, while Tidd *et al.* (2005 pp88-97), the OECD (1992 p25) and other models have also featured feedback loops between the various stages of the process. Indeed, Rothwell's (1992) five generations of innovation models recognise that feedback loops occur from the different elements in the models from the third generation onwards. Feedback is a concept found in the performance literature as well as the innovation literature, where research has highlighted that effective performance measurement systems involve feedback of information on the performance of the product (Fortuin 1988, Globerson 1985). The latter describes how feedback closes the management loop, again suggesting that information is exchanged between organisations and actors as in the innovation literature and as was observed empirically.

Training was another form of exchanging information on performance measurement between actors (Lebas 1995). While literatures beyond the scope of this study such as human resource management refer to training extensively, there is less discussion in the literatures drawn on here. However the innovation literature refers to training of individuals in organisations to cope with operating a new piece of equipment and training has been associated with innovation capability in much existing research (Leonard Barton 1992, Robinson & Schroeder 1993). Much of this literature concentrates on the individual actor, as was observed in the empirical work where the training was given to the patient or clinician user of the innovative product. The empirical work found that much training occurred between individual actors, which was also found to be a key influence upon adoption of new technologies in the supply literature (Reunis *et al.* 2004), though in this example from an intra-organisational perspective.

7.3.2. Making the Purchasing Decision

The purchasing and supply management, and the innovation theory bodies both shed some light on making the purchasing decision.

Making the Purchasing Decision in the Purchasing and Supply Management Literature

The purchasing and supply literature includes a lot of work on the strategy of purchasing and supply with implications for purchasing decisions, though a smaller amount has studied making the purchasing decision. Additionally, the emerging evidence-based literature highlights how the performance literature refers to using performance measurement information in making a purchasing decision. Much of the work on decisions has involved strategic decision making from an economics and operations research standpoint (Tamura 2005), rather than a purchasing and supply or organisational behaviour viewpoint. Overall, information that had been gathered was analyzed and a decision then taken, as highlighted in the literature review (Webster & Wind 1972 pp12-39, 77-107, Harland *et al.* 2004, Biemans 1992 p48, Rogers 2003 pp169-194). As stated in the cross case findings, making the purchasing decision can take the form of a tender process, or decision-making by an individual clinician or user. The tender process is discussed in the purchasing literature, with a focus on tendering in public purchasing and compliance or non-compliance with the process (Gelderman *et al.* 2006). Key parts of the tender process include scoring and weighting of performance measurement data, decision-making involving a committee of clinicians and managers set up especially for the task as a formal buy group (Webster & Wind 1972 pp28-37) and debriefing of suppliers. The roles of members of the buy group were identified amongst the interviewees in the four cases, however they can also be applicable to the members of the buying committee in the CT scanner case. Webster and Wind (1972 pp77-87) refer to the buying committee as a group decision-making process, as well as to decision stages and roles in the buying centre. Members interact with inter-personal influence occurring as part of making the purchasing decision.

Less formal decision-making about whether to purchase the innovative product or not, or which product to purchase from a range of competing products, also occurs. The most useful literature in this respect is that covering behavioural decision-making, a number of examples of which are given here. Lindgreen and Wynstra (2005) reviewed literature describing how customers trade off different value offerings in making the decision of which product to purchase. As discussed above, Webster and Wind (1972 pp28-37, 89-106) describe not only how individuals evaluate the various options in purchasing, but also how the decision is made, with relevance for the processes carried out by the individual clinicians in the cases. Webster and Wind (*ibid.* pp88-107) described how buyers have a variety of predispositions, preferences and decision models, influencing the outcome of the individual's decisions as shown graphically in the literature review. The description sheds some light on the subjective nature of the decision-making that many clinicians and other purchasing decision-makers were observed to be undertaking. It describes how the individuals responded behaviourally to various stimuli, including information from performance measurement and the input of supplier sales representatives.

Having reviewed the behavioural decision-making literature, Mantel *et al.* (2006) highlight that the key factors of decision making with relevance to supply managers are task related characteristics of the decision, personal characteristics of the decision maker and contextual characteristics for the decision. Different information used to make the decision can be emphasised or discounted in the process and the way in which performance measurement information is presented to the decision maker may result in them noticing or ignoring it (Tversky & Kahneman 1974). The ease of the individual visualising a possible outcome of the decision and their response to risk, including when making decisions about medical treatment (Tversky & Kahneman 1986) also influence the decision. Mantel *et al.* (2006) discovered the importance of individual humans, rather than organisations in making decisions in a supply context, where the source and nature of information plays a role in its take up, with informal information being used in particular. This backs up the empirical observations that many of the purchasing decisions were made by local level clinicians in the NHS on the basis of their own subjectivity and experience and further that some performance measurement information was used and others not.

Decision-making is described as a key part of networking (Grandori & Soda 1995). Harland *et al.* (2004) point out that much less research has looked at the process in supply relationships and networks than in the organisational behaviour field, however decision-making can be a challenge where information is dispersed and there is a lack of a clear structure of authority. Further, decision-making processes often take the form of combining objectives and information, with established routines and processes emerging, as found empirically with the decision making of individual clinicians or the Trust tender process in the CT scanner case. Puto (1987) reinforces the point about objectives, but describes reference points which individuals use to compare performance, which is reminiscent of the empirical data where buyers compared the performance of the product against a particular standard. The network pictures and range of decision making respondents highlight the lack of authority structure in the cases, while the various exchanges of performance measurement information that occurred reinforce the suggestion that information for decision making is dispersed. The environment and atmosphere of the firm also influences decision making in relationships (IMP Group 1982), though the literature is not clear about the role of factors such as organisational climate (Qualls & Puto 1989), so the NHS context is perhaps better understood through Mantel *et al.*'s (2006) concept of supply context.

From the performance literature, work on evidence-based themes also describes making the purchasing decision, using information from performance measurement. The focus is on the application of evidence in decision making (Kovner & Rundall 2006). The performance literature in general does not refer specifically to the purchasing decision, only to performance measurement and systems of performance management (Radnor & Barnes 2007), though the latter is sufficiently loose to cover processes of purchasing decision making.

In summary, the literature reinforces the empirical observations that much decision-making making was carried out locally by actors in a subjective manner, using limited information from the network.

Making the Purchasing Decision in the Innovation Literature

The innovation literature also discusses the decision to purchase the product through concepts such as adoption, diffusion and implementation, as discussed in the literature review. In studying the process of buying medical devices, Biemans (1992 pp129-140) gives eight steps, including recognising a problem, determining characteristics of the item needed, searching for and evaluating potential sources, then selection from those sources. The steps describe how performance measurement information is used in subsequent purchasing decisions. Rogers (2003 p170) also describes decision making stages in the innovation process and although it is predominantly from a supplier perspective, it demonstrates adoption or rejection options for the customer.

Zaltman *et al.* (1973 pp53-55) reinforce Harland *et al.*'s (*ibid.*) point that decision making involves combining objectives and information, but with a specific focus on decision making individuals and the uncertain conditions in the innovation field. They describe how individuals will select different innovations by generating subsets of courses of action available, attaching consequences to each, ordering preferences and selecting the first choice that meets the minimum satisfaction sought in each of the preferences. The steps bear a similarity to Biemans (1992 pp129-140) in that they involve selecting from options against criteria, using performance measurement information. Although many buyers in the empirical work were attempting to choose the best product, not one that just satisfies the criteria, Zaltman *et al.* sheds some light on the subjective process the decision makers go through by identifying the consequences of their purchase decision. This suggests that clinicians generate an alternative course of action when communicating with others about the product or testing it, then evaluate the various types of performance consequences and deciding to buy or not buy the product or perhaps a competing product instead.

Zaltman's behavioural view of buying decision making by clinicians and others is consistent with the subjective assessment of various types of performance in the behavioural literature as described by Cohen and Blum (2002), above. Further, the behavioural studies of individual actors in supply relationships have discussed psychological contracts that develop trust and commitment (Kingshott & Pecotich 2007), as found at the local level in many cases between the supplier representatives and clinicians.

The original literature review highlighted that there was limited knowledge on specific performance management processes. However a renewed look at the literature following the empirical findings about making the purchasing decision has suggested that this is indeed a performance management process (Radnor & Barnes 2007) and has described it in more detail through existing research. To summarise, Bazerman (2005 pp1-10) describes the anatomy of a decision, involving problem definition, criteria identification and weighting, generation of alternatives, rating of alternatives on each criterion and finally computing the optimal decision. Given that the model assumes rational decision makers, he then points out the concepts of bounded rationality and simplifying assumptions or heuristics that are used by individuals in practice, reinforcing points made by other researchers, described above. Overall, the decision process reflects both formal processes such as the tender process in the CT scanner case, as well as shedding light on the way that individual buyers in other cases went through a similar process but in a more subjective manner influenced by heuristics in a bounded rationality.

7.3.3. Product Innovation

The literature provides plenty of background to the finding that performance of the innovative projects are managed by a process of product innovation. Although the innovative products studied in the cases had all been implemented in the marketplace, subsequent innovation occurred. This sub-section returns to the literature to look at how changes are made to the product during implementation as part of the innovation process and also at customisation of the product, as was observed in the empirical work.

The process models of innovation discussed in the literature review describe how changes are made to the design of the product in both the initial implementation stage and once implementation has occurred and the product is in the marketplace. In their generic model of the innovation process, Tidd *et al.* (2005 pp88-97) referred to launching the product as involving sequential collection of information and problem solving towards the point of final launch. Some of the process models of innovation include stages of commercialisation (Booz *et al.* 1960 pp10-11, Adams *et al.* 2006), describing the activities of getting the innovative product accepted for implementation by the market. Studying medical devices, Shaw (1985) found that many or continuous interaction between suppliers and users were important for understanding the needs of the user through trials, to make a successful product. An example from the empirical work is the alpha and beta testing with users carried out by the CT scanner supplier.

Once the product has been launched, process models of innovation describe how learning from the performance of the product in the marketplace and the customer is used to sustain the innovation (Tidd *et al.* 2005 pp88-97). This takes the form of learning from the performance of the product at the latter, implementation stages of the innovation process and then using that information to make more improvements to the design of the product or service package. This fits with recent literature describing innovation as an open (Gassmann 2006) and less linear (Collins 2006, Schoen *et al.* 2005) process. In the case studies, all suppliers were seen to gather information from the customer or user, even if only informally, which was then fed back to the head office or design team. Rothwell and Gardiner (1985) refer to subsequent improvements once the innovation has been launched as 're-innovation' and point out the role of the user in this process, reinforcing seminal innovation literature on the role of lead or key users in product innovation (Von Hippel 1986).

Feedback is a key theme of the process models of implementation (Tidd *et al.* 2005 pp88-97, Rogers 2003 pp169-194, Zaltman *et al.* 1973 p62-78) with the latter work having reviewed several such models, as well as in the performance literature (Globerson 1985). Feedback is also described as an important part of the purchasing process (Van Weele 2002 pp14-17). Feedback involves gathering information about how the product performs from the customers, so that the lessons learnt can be used to improve the next generation of the product (Nonaka & Kenney 1991). The literature on feedback gives a context to the findings that information is gathered about performance of the products, before being fed back to the supplier. Schein (1970 p120) stresses that feedback is used to help organisations adapt, highlighting that feedback is used to then make changes to the product, or control the innovation process (Zaltman *et al. ibid.*).

Indeed, many of the cases suggested that continuous improvement or continuous innovation (Boer & Gertsen 2003, Cole 2002) was occurring, as the supplier described a constant process of gathering feedback from customers and users and using this to improve the product. Imai *et al.* (1985) provide a neat summary of the point by suggesting that innovation is a dynamic process that is incremental, iterative and involves continuous learning about the product and adaptation of it to changes in the environment. This was seen in practice, where the product in every case had either been produced in several successively improved versions, or was an updated version of a previous, similar product. Boer *et al.* (2001) also refer to continuous innovation and reinforce the discussion of making product changes at different parts of the innovation process, above. They make the point that competition is encouraging companies such as the suppliers in the empirical work to both learn and then apply the knowledge gained at an increasingly wide number of stages of the innovation process.

In addition to the general literature on product innovation, customisation is discussed and helps illustrate the observations of suppliers customizing the product package for customer needs. This can be seen as a type of experiental innovation (Moore 2004) in which surface modifications are made to the product to improve the experience for the customer. Also, implementation (Tidd *et al.* (2005 pp88-97) of the product focuses upon changes made for particular customers.

The literature on customisation is dominated by mass customisation in large scale manufacturing industries (Jiao *et al.* 2003), however some previous work has discussed customisation of products for individual customers. Stump *et al.* (2002) describes how suppliers frequently customise product offerings as part of the broader adaptation processes that occur in a relationship with the customer. In line with the social and informational exchange that occurred between customer and supplier individuals in the cases where customisation was noticed, Stump *et al.* (*ibid.*) point out that customisation: *"…usually requires considerable seller-buyer interactions aimed at matching the seller's technological capabilities with the buyer's needs…"*. As the relationships observed in the empirical work were found to be more collaborative between individuals at the local level, Hallen *et al.* (1991) comment that customisation is part of adaptation in collaborative relationships. Easton and Rothschild (1987) describe how organisations reach a limit where customisation is used so that the product is no longer supplier specified, but customer specified. Spring and Dalrymple (2000) concur that customisation involves exchange between customer and supplier actors, especially where the product is not just custom built as in the CT scanner case, but custom designed as in the example of the standing frame headrest.

To summarise the discussion of performance management processes, Table 36 shows key performance management processes described by respondents in the case studies, interpreted in the light of the existing literature where possible. The processes identified in this section and the last section on performance measurement as well as in tables one and two are closely related, presenting the challenge of differentiating between the concepts of performance measurement and performance management. The processes have been included here in the findings as performance measurement or performance management according to the definitions given in the conceptualisation, focussing on performance management as broader. On reflection however it is not clear whether some are measurement or management processes. For example communication with other actors to gather information about performance could involve gathering opinions to measure product performance, or could be a follow up or management process. Differentiating the two is further discussed as part of the next section on influences of the processes.

Process From Cases	**View of the Existing Literature**	**Empirical Finding in Context of Existing Literature**
Performance Management Processes		
Dissemination of Performance Measurement Information; Processing & disseminating of performance measurement data, Advice, Feedback, Training	• Information exchange between actors (IMP Group 1982, Bambra 2005). • Tabulating and processing of performance measurement data (eg Kaplan & Norton 1992). Measures should provide information (Fortuin 1988), be presented with impact (Lea & Parker 1989). • Feedback promoted following performance measurement (Globerson 1985, Rothwell 1992). • Training of individuals (Leonard Barton 1992).	Disseminating information from performance measurement often occurred after performance measurement, including feedback, training. Literature describes information exchange between actors, feedback and training.
Making the Purchasing Decision; Purchasing decision made on the basis of performance measurement information, Purchasing tender process, decision making by individual actors at customer	• Tender processes guided by regulations, compliance varies Gelderman *et al.* (2006). • Decision-making in the purchasing team, or by individual (Webster & Wind 1972 pp28-37, 89-106). • Information gathered, analyzed and decision taken (Harland *et al.* 2004) • Behavioural view of decision making (Bazerman 2005 pp1-10). • Key factors of decision-making for individual supply managers (Mantel 2006). • Factors affecting, nature of decision making (Tversky & Kahneman 1986, Puto 1987, IMP Group 1982, Kovner & Rundall 2006. • Decision-making steps in adoption of innovation (Biemans 1992 pp129-140).	Empirical findings identified making the purchasing decision as a key management process. Literature gives some information reinforcing how individuals use information in making purchasing decisions.
Product Innovation; Product re-designed in response to performance measurement information, Supplier customises product package for needs of particular customer or user	• Innovation is a dynamic process (Imai *et al.* 1985). • Feedback is gathered to improve the product (Nonaka & Kenney 1991). • Sequential information collection, problem solving (Tidd *et al.* 2005 pp88-97). • Re-innovation (Rothwell & Gardiner 1985). • Customisation involves considerable customer-supplier interactions (Stump *et al.* 2002).	Findings showed process of innovating product does not finish after implementation, is improved with feedback on the performance of the product. Literature refers to iterative process, re-innovation, customisation.

Table 36. Summary of Key Performance Management Processes and Observations from the Cases Interpreted with the Literature

7.4. Influences of Processes in the Context of the Literature

The influences of the performance measurement and performance management processes were identified in the exploratory empirical work and subsequent analysis, however returning to the literature provides some background to the empirical findings. This is highlighted first, followed by discussion of the empirical findings in the light of a key issue stated in the literature, namely how the empirical findings can be used to draw a conceptual distinction between performance measurement and performance management processes. Findings are discussed with respect to literature concepts that performance management is broader than or involves follow up planning and control action on performance measurement (Halachmi 2005, Lebas 1995); or that performance management influences performance, unlike performance measurement (Bourne *et al.* 2005, Halachmi 2005, Melnyk *et al.* 2005).

7.4.1. Influences of the Performance Measurement and Performance Management Processes

The previous chapter highlighted a number of overall influences which the performance measurement and performance management processes had in performance of the innovative product. The particular influences described by respondents were first described conceptually, then grouped in various ways until groups of beneficial, non-beneficial and no influences were identified as the clearest clusters. This sub-section discusses the conceptual influences identified from respondents across the cases in the light of the literature. Only influences identified in a pattern across more than one case are included here, as stronger findings. Discussion of the clusters takes place as part of examining conceptual distinctions between performance measurement and performance management in the following sub-section.

Product is Purchased or Not

Many of the influences discussed by respondents are to do with the purchasing decision and using the performance measurement information in that purchasing decision. In their success measures for product development, Griffin and Page (1996) describe aspects of success that actors in the cases derived from the outcome of the purchasing decisions taken. For example, ‘met profit goals’ and ‘return on investment’ describe some of the financial performance outcomes for the suppliers if the decision was made to purchase the product. Also, ‘customer satisfaction’ and ‘customer acceptance’ describe some of the customer performance outcomes that the clinician and patient users of the NHS gain from the product if it is bought.

Some of the literature referred to above, describing the use of performance measurement information in purchasing decisions also implies the influence of these processes in performance of the product. Indeed, the process based models of buying behaviour (Webster & Wind 1972 pp12-39) and innovation (Zaltman *et al.* 1973 p62-78) assume an operations management ‘planning and control’ view of a process with inputs and outputs (Godwin *et al.* 1989). The outputs of the buying behaviour models described by Webster and Wind (*ibid.*) are whether particular tasks were completed or problems solved. In innovation models, the literature refers to whether a product was adopted or rejected (Rogers 2003 p170) and its implications for a successful innovation and either the supplier to gain a competitive edge with competitors, or for the NHS customer to get a better edge when tackling healthcare problems (Tidd *et al.* 2005 pp39-41). Most of the innovation literature concentrates on innovative product performance at the level of the firm rather than the product, however literature reviews studying success of new product development (Ernst 2002) and new industrial product performance (Lilien & Yoon 1989) suggest that a successful innovation is one that leads to success for the organisation as an innovator. Yoon and Lilien (1985) refer to a successful product as one that achieves good sales performance, while Maidique and Zirger (1984) suggest that successful innovative products are better matched to the needs of the user, amongst other aspects of performance.

The literature discussed in preceding sections has described how the source and nature of information dictates whether it is used or not in the purchasing decision by a particular decision maker (Mantel *et al.* 2006). When this is considered along with the various influences on a purchasing decision in the behavioural literature, the previous research has described how the purchasing decision and the information on which it is based has had an influence in the performance of that product for the various actors involved.

Product Can be Purchased or Not for Short-Term, Cost Based Rather than Broader Reasons

Respondents in all cases described how the product could be purchased, but for short-term reasons with a focus on cost. In this finding a different influence of the purchasing decision and information involved occurred, in buying a lower cost product. Referring back to the behavioural decision-making literature, this suggests that the decision taken was different, that the information involved was different or perhaps something in the decision context.

Melnyk *et al.* (2005) found that actions that encourage reducing costs can adversely affect broader actions intended to promote innovation, unintentionally. The evidence-based literature also sheds light on the issue, illuminating the role described by many of the respondents. It suggests that decisions should be based on the best available evidence and logic from both inside and outside the organisation (Pfeffer & Sutton 2006). If a product is bought for short term reasons on the basis of cost evidence alone, rather than broader aspects of technical or customer performance, the evidence-based literature suggests that the decision made is not evidence-based, through using insufficient or inadequate performance measurement information or the context of the organisation where that decision was taken. Gershon (2004 pp5-8, 35-36) and others highlighted the need to achieve cost efficiencies in public purchasing and many of the cases indeed showed that cost of the innovative product limited whether it could be bought or not, for example the standing frame, while Tzokas and Saren (1992) suggested that customer receptivity to innovations is a factor affecting their uptake. However the context in which the decision was taken is something that was not sufficiently described in the empirical data and is discussed in the limitations part of the next chapter. Purchasing decisions that are not evidence-based may have a non-beneficial effect on performance, as the product chosen is not the one that performs optimally for the particular need according to the best available evidence.

Performance Measurement Information is Not Used in the Purchasing Decision

Just as the empirical work found that performance measurement information was used in purchasing decisions, so too were there instances described across the cases where performance measurement information was not used when a purchasing decision was taken. Explanation is provided by Mantel *et al.*'s (2006) finding that the importance of the source and nature of the information available affect it's take up in decision making. For example, Evaluation Centre reports were variously used or not for diverse reasons such as their format, availability, cost and timeliness. Lengel and Daft (1988) describe how impersonal media such as static reports are less rich than more personalised media. In short, the behavioural decision-making literature suggests that the nature of the performance measurement information, coupled with other contextual influences of the decision, can mean that information may be used in some purchasing decisions but not others. Accordingly, in each case, performance measurement information was used for some purchasing decisions, but not others.

Product Design Improved

The literature discusses how the innovation process including re-innovation and customisation processes changes the design of the resulting products. Rothwell and Gardiner (1988) describe states of technical change of a product, which progresses from the basic idea, through invention to innovation and then finally to re-innovation. The last step, reflecting the empirical data, involves a process of re-design, meeting the central design issue of whether the product can be made: "…*better or cheaper or both…*". Feedback loops in the innovation process have been described as important so that emerging problems with products, such as the design issues with the blood glucose meter and ECG monitor, can be dealt with effectively (Zaltman *et al.* 1973 pp70-78). Similarly, Olsen *et al.* (2007) referred to the importance of performance measurement in monitoring, controlling, evaluation and feedback management functions. Further, it is not only design problems that are resolved by performance measurement, feedback and re-innovation, but the design of the product is continuously improved. Boer *et al.* (2001) describes how organisations can improve their competitive advantage from product innovation by moving from isolated projects to continuous innovation, utilising learning and knowledge from within and outside the organisation.

Customisation, as observed in the standing frame and CT scanner cases, is also described in the literature as improving performance of the product for particular customers or users. Athaide & Stump (1999) point out the benefits of customisation from the point of view of suppliers, who can gain a source of competitive advantage and the means to offer improved value to the customer. Stump *et al.* (2002) highlights that customised products are beneficial as they more closely meet idiosyncratic needs from the point of view of the customer. Spring and Dalrymple (2000) relate customisation to performance, by its influence in improving the operating characteristics of the product.

Feedback to the Supplier is Not Used

Feedback was found to be a key process with an influence in improving the design of the product as described above. However, the empirical data also found that feedback was not used. Given that feedback involves the dissemination of information from performance measurement, the finding that use of feedback to improve the product varies is similar to the findings that use of performance measurement information in making the purchasing decision varies. The innovation literature promotes action on feedback to improve the product, suggesting that many organisations do not act upon their feedback, however the above finding suggests otherwise for the organisations in the case studies. Again, Mantel *et* *al.*'s (2006) finding is of relevance, that the type and source of information influences how it is used by decision makers in the innovating organisation. The point about the source of information is of interest, as feedback was gathered through the supplier's own representatives, as well as being given by customers themselves. It is possible that supplier actors as behavioural actors are more likely to use information from staff in their own organisation. Zaltman *et al.* (1973 pp70-78) do not only state the importance of feedback in the innovation process as described above, they emphasise that: "*…although the creation of feedback mechanisms is a prerequisite for adequate handling of emerging implementation problems, it is not in itself a "safeguard" assuring such handling. The information that the feedback mechanisms provide must be interpreted to become useful."* (p77). This makes the point that measuring the performance of the product and disseminating that information is only of use if action is then taken.

Training is Necessary for Patient to Gain Benefits of Product Use

The empirical findings emphasised the importance of training for the user to gain the benefits of using the product. Training is discussed in the literature, though largely from the point of view of a supplier organisation training staff, rather than product users. However the work makes the point that staff in organisations must utilise knowledge and skills about a product or process for the organisation to make the most effective use of the innovation (Pfeffer 1994). This point could apply to the NHS actors who make use of innovative products purchased by the organisation. Indeed, Bessant and Buckingham (1993) state that training is a key determinant of whether an innovation is implemented successfully. The article has relevance for innovative products that are potentially used throughout the NHS, such as those in the empirical case studies.

The finding about the importance of training also highlights the importance of using the product, or action. The performance literature in particular emphasises action on feedback by closing the management loop (Globerson 1985) and the broad concept of performance management as taking action on measures (Neely *et al.* 1997). At a fundamental level, the use of the product represents a proactive part of a planning and control view of management (Mintzberg 1990).

Compliance With Use of the Product is Needed

Further to the above point that action must be taken on feedback, the findings raised the issue that not only must a suitably performing product be bought for the customer, but it must actually be used. Again this picks up on the concept of action on performance measurement from the performance literature, but also touches on the concept of compliance in medicine. Cramer *et al.* (2008) reviewed research into patient compliance with a variety of clinical treatments, including in the diabetes and cardiac areas. They found that good compliance beneficially influenced clinical outcomes in 73% of the studies reviewed, yet there is a significant problem presented by non-compliance, particularly for cardiovascular and diabetes medications. This influence highlights compliance, or using the product, as a further performance management process involving taking action (Halachmi 2005, Neely *et al.* 1997, Globerson 1985), that is important if the previous performance measurement processes and performance management processes such as purchasing the product are to have an influence on performance.

To summarise the discussion of the influences, Table 37 shows the key influences identified in the cross case empirical findings, interpreted in the light of the existing literature.

7.4.2. Conceptual Distinctions Between Performance Measurement Processes and Performance Management Processes

The original literature review highlighted that there is little clear conceptual distinction between the terms performance measurement and performance management. This sub-section discusses conceptual distinctions between the terms in the light of the empirical findings. Firstly, it looks at performance management as broader processes than performance measurement, then it looks at another literature theory of performance management as taking follow-up planning and control action upon measures, where a performance change occurs.

Performance Management as Broader then Performance Measurement

The existing literature suggested that performance measurement is a sub-system of performance management (Halachmi 2005), a concept also developed by Lebas (1995) and used in the conceptual framework. If performance measurement is defined as: "*…the process of quantifying the efficiency and/or effectiveness of an action.*" (Neely *et al.* 2005), then any process broader than that quantification must be performance management. Actors measured technical aspects of the products using instruments to gain a quantification of the way that they acted, such as testing the radiation dose of the CT scanner using a dosimeter, which gave a quantitative score of the amount of radiation emitted by the product, a key parameter of interest to clinicians operating it. Financial performance was also measured by the actors according to this definition, for example calculating the sales levels or return on investment, a quantification of the efficiency and effectiveness of a commercial product. Customer performance was measured, an example being the market research carried out for the blood glucose meter supplier involving quantitative surveys of opinion of product users.

Influence, From Cases	**View of the Existing Literature**	**Empirical Finding in Context of Existing Literature**
Product is Purchased or Not	• Success measures the organisations gain or lose when product is purchased or not (Griffin & Page 1996). • Outputs of buying behaviour models are whether tasks completed or problems solved (Webster & Wind 1972 pp12-39). • Whether a product was adopted or rejected by customer (Rogers 2003 p170). • Source and nature of information dictates use or not (Mantel *et al.* 2006).	Many of processes have an influence on whether the product is purchased or not. Literature reinforces that purchasing decision, using information from performance measurement determines whether product is purchased or not.
Product Can be Purchased or Not for Short-Term, Cost Based Rather than Broader Reasons	• Evidence-based decisions are imperative, they are based on the best available evidence and logic from inside and outside the organisation (Pfeffer & Sutton 2006).	Short-term, cost based reasons can influence whether the product is purchased or not. Evidence-based literature suggests explanation.
Performance Measurement Information is Not Used in the Purchasing Decision	• Source and nature of performance measurement information dictates use or not in purchasing decision by a particular individual (Mantel *et al.* 2006).	Literature also reinforces the finding, as the nature of information dictates use.
Product Design Improved	• Re-innovation see if product can be made better, cheaper or both (Rothwell & Gardiner 1988). • Feedback deals with emerging product problems (Zaltman *et al.* 1973 pp70-78). • Customisation gives competitive advantage, means to offer improved value (Athaide & Stump 1999), products that more closely meet needs (Stump *et al.* 2002).	Findings are supported by literature concepts of re-innovation on the basis of feedback, and customisation.
Feedback to the Supplier is Not Used	• Information from feedback mechanisms must be interpreted to become useful (Zaltman *et al.* 1973 pp70-78).	Both suggest information from performance measurement, including feedback may not be used.
Training is Necessary for Patient to Gain Benefits of Product Use	• Training is key to implement successfully (Bessant & Buckingham 1993). • Importance of action on measures (Neely *et al.* 1997, Globerson 1985).	Literature concurs with empirical findings that training is important for successful use of an innovation.
Compliance With Use of the Product is Needed	• Importance of action on measures (Neely *et al.* 1997, Globerson 1985). • Compliance beneficially influences clinical outcomes (Cramer *et al.* 2008).	Literature reinforces empirical findings that action on measures is important.

Table 37. Summary of Key Influences of Performance Measurement and Performance Management Processes from the Cases Interpreted with the Literature.

Many broader processes than those suggested by Neely *et al.* (2005) were encountered in the empirical work, while the literature is explicit about feedback (Globerson 1985) and follow up action (Neely *et al.* 1997, Zaltman *et al.* 1973 pp70-78). A tighter definition of what Neely *et al.* (2005) might mean by quantification, yet allowing for qualitative measures described by others (e.g. Kaplan & Norton 1992) is given by Farbey *et al.* (1993), describing a system preserving the difference between a set of entities by using a set of symbols. Farbey *et al.* (*ibid.*) give a more limited description of the actual process measurement consists of and again many of the processes described by respondents in the empirical work were broader than this, such as disseminating information from performance measurement, gaining feedback from suppliers and various types of action on the information. However a criticism of the work is that it does not reflect the subjective nature of many performance measurement processes as found in the empirical work and discussed elsewhere in the literature (Baker *et al.* 1994), such as social exchange between actors (IMP group 1982). Such processes go against many of the recommendations on measuring performance, such as being objective rather than based on opinion (Fortuin 1988) and being clearly defined (Globerson 1985). However it still involves a process by which aspects of product performance are measured according to Farbey *et al.* (1993), aspects that are often eventually scored, or quantified in the CT scanner case for example. Given the subjective nature of many of the measurement processes observed in the empirical work and having observed that many interview respondents used the two terms interchangeably, implies that the boundary between the two concepts is not clear cut. For example, there is the challenge of determining where a subjective performance measurement process, of social exchange between a supplier representative and clinician, instead becomes a broader performance management process of disseminating information. Also, feedback can be interpreted in the light of existing literature as a way of measuring performance as it involves quantifying or qualifying an aspect of the performance of a product. However the literature could also be used to interpret it as a broader management process.

Defining performance management as a broader concept than performance measurement reveals performance measurement to be a narrow and limited subset of performance management. However the empirical data suggests that the boundary between the two concepts is blurred so another theory from the literature of differentiating the two concepts, on the basis of their influence on performance, is discussed next.

Performance Management as Taking Action on Measures, Where a Performance Change Occurs

As discussed above, performance management has been described as taking action upon performance measures (Neely *et al.* 1997, Zaltman *et al.* 1973 pp70-78), with the literature suggesting that performance management processes are those that have an influence on performance (Halachmi 2005, Bourne *et al.* 2005, Kaplan & Norton 1996) through the action taken. Halachmi (*ibid.*) writes: *"…to challenge the notion that simple performance tracking by itself is capable of improving performance…in order to advance performance there is a need to manage performance rather than simply measure any given aspect of it…"*, going on to describe management as involving decisions about using resources efficiently and effectively, planning and controlling to achieve results that are desired. Melnyk *et al.* (*ibid.*) implies follow up processes of performance management by stressing the importance of linking performance measurement metrics with value drivers and strategy. They quote Ittner *et al.* (2003a) as having found that improved alignment improves performance of the firm. Kaplan and Norton (1996) move on from their original focus on performance measurement to look at how to use their balanced scorecard as part of a strategic management system. Robson (2005) concurs, emphasising the importance of following performance measurement with action as part of a control and process system if improvements in performance are to be achieved. Overall, these definitions of performance management concern processes that organisations use to control performance, as reflected in overall views of the concept of management as involving planning and control (Mintzberg 1990, Slack *et al.* 2007 p24-25).

The processes that are broader than performance measurement alone as discussed above involve some sort of action that follows performance measurement and can therefore be described as performance management processes in the light of the literature just discussed. These processes include disseminating information from performance measurement, feedback (Globerson 1985, Fortuin 1988, Van Weele 2002 pp14-17), making the purchasing decision (Webster & Wind 1972 pp28-37, 89-106, Bazerman 2005 pp1-10) and re-innovation of the product (Rothwell & Gardiner 1985) for example. Globerson (*ibid.*) emphasises the necessity of feedback as part of effective management planning and control for example, while Rothwell & Gardiner (*ibid.*) describe re-innovation in the manner of management as a planning and control process. However the empirical data gathered shows that the performance measurement and performance management processes vary in the influence they have on performance.

Where an influence on performance occurred, the empirical data suggested that both the basic performance measurement processes (Farbey *et al.* 1993, Neely *et al.* 2005) and follow up performance management processes involving action on performance measurement data were present. For example, information from performance measurement processes was used in making the purchasing decision, the processes together having an influence on whether the product was bought or not. Information from performance measurement processes was also used in a re-innovation process, the processes together having the influence of improving the design of the product. Further emphasising the importance of performance management processes, action had to be taken to comply with use of the product and train the user if the product was to perform for the customer or user, highlighting that more, proactive performance management processes are needed as well as performance measurement processes if they are to have an influence on performance (Halachmi 2005, Bourne *et al.* 2005, Melnyk *et al.* 2005). If information from performance measurement is used in a purchasing decision and they together have an influence on performance, the empirical findings suggest the breadth of information used will influence whether the influence on performance is beneficial or non-beneficial (Pfeffer & Sutton 2006).

On the other hand, where performance measurement processes occurred alone without many, proactive performance measurement processes, there was not an influence on performance. For example information from performance measurement was not used in making purchasing decisions or in making improvements to the product. According to Halachmi (2005): *"The basic premise of the concept of performance management is simple: great performance…is unlikely to happen on its own"*.

That some of the performance management processes do not have an influence on performance would suggest that they are performance measurement processes instead. However, disseminating performance measurement information and feedback are broader than the basic process of measuring performance (Farbey *et al.* 1993, Neely *et al.* 2005). These processes can also be viewed on a blurred dividing line when defining performance measurement and broader performance management (Lebas 1995). Radnor and Barnes (2007) present an answer to this issue by conceptualizing not only performance measurement (*"…quantifying, either quantitatively or qualitatively, the input, output or level of activity of an event or process."*) and performance management (*"…action, based on performance measures and reporting, which results in improvements in behaviour,* *motivation and processes and promotes innovation.”*), but an intermediate concept of performance reporting: *“…providing an account, and often some analysis, of the level of input, activity, or output of an event or process usually against some form of target.”*. Radnor and Barnes (*ibid.*)’ definitions suggest that those processes in the empirical work with an influence on performance are performance management processes, whereas those that do not have an influence on performance on their own are performance measurement and reporting processes. The next section draws out the conceptual lessons from the discussion in this and preceding sections of the chapter, returning to the conceptual framework.

7.5. Dialogue on Findings and Conceptual Lessons

This section cultivates the dialogue about the findings and develops key lessons learned from the research, regarding the conceptual structure. The study has identified a range of performance measurement processes and performance management processes from the empirical work, as well as their influence on performance. These are discussed in the following sub-sections and the conceptual framework is then revised, illustrating conceptual lessons. To do this, the two ways of differentiating performance measurement and performance management in the literature are reviewed as part of the discussion about drawing a distinction between the processes discovered in the empirical work.

7.5.1. Performance Measurement and Performance Management Processes

Performance measurement processes in the empirical work varied in terms of the methods used and the aspects of performance that they measured. Both formal, objective and less formal, subjective performance measurement processes were used by actors in the cases. Given that the literature tends to focus on the former, the high occurrence of the latter was of particular interest. The aspects of performance measured also varied a lot and the Griffin and Page (1996) dimensions of product success measures are used as a framework, broadly representing the financial, technical and customer aspects of performance of the product that were measured.

Further to the processes that were involved in actually measuring performance according to fundamental definitions (Farbey *et al.* 1993 pp75-94), processes such as dissemination and feedback of the information from performance measurement were observed as occurring. The empirical work also highlighted the role of social and information exchange as a more subjective and often less formal performance measurement process. However this finding raises the question of whether social and informational exchange is a performance measurement process, as described so far in the findings, or not. It has been assumed to be a performance measurement process throughout the findings chapters as it involves gathering information, however it can also be seen as a broader, or follow up (Lebas 1995) process. Remembering the Lebas graphical depiction, it involves those parts of performance management other than performance measurement, so some sort of planning (Mintzberg & Lampel 1999) or planning and control (Slack *et al.* 2007 p24-25). The networks literature (Nohria 1992, Uzzi 1997) also suggests that social exchange to gather information is a broader process than performance measurement, though it is used in broader, performance management, processes such as innovation (Grandori & Soda 1995). However there is little evidence that social and informational exchange alone could influence performance and therefore be a broader performance management process (Halachmi 2006). The strongest steer from the literature that aids understanding social and information exchange is again performance reporting (Radnor & Barnes 2007). This allows that social and information exchange can indeed be broader than performance measurement, while satisfying the concern that it is not conceptually similar to those performance management processes that influence performance, such as re-innovation for example.

This discussion has highlighted that processes discovered in the empirical work, such as feedback, dissemination of information and social and informational exchange, are performance reporting processes. These processes must be reflected in a revision of the conceptual model to highlight that they are fundamentally different to performance measurement processes, yet do not have an influence on performance as the performance management processes do. With respect to their influence, these performance reporting processes (Radnor & Barnes 2007) are grouped with the performance measurement processes, due to their lack of influence on their own on performance, as described above. However the framework is modified below to distinguish performance measurement from performance reporting.

Overall, understanding of the concepts of performance measurement and performance management has been clarified through comparing the empirical results with the literature. The nascent nature of the performance literature means that some interesting ideas are generated here, as the network and strategy literatures have been considered together for example. However the discursive process has highlighted that research in the area needs a bolder appreciation of new concepts in the area, such as performance reporting and the overall concepts of management. Revisions to the conceptual framework and the future research discussed in the last chapters of the thesis offer opportunities to take this further.

The case studies also identified some key performance management processes. Information gathered through the performance measurement and performance reporting processes was then fed back through the innovation process, where re-innovation of the product occurred. Much of the information from performance measurement and reporting was also used in a broader or follow up process of making purchasing and supply decisions, a way in which the performance of the product was managed.

Further, if the preceding performance measurement and performance management processes are to have an influence on performance, there must be compliance with use of the product. Although not explicitly described by respondents as a performance management process, compliance or use of the product is broader than (Lebas 1995), and involves follow up action (Globerson 1985, Neely *et al.* 1997) on performance measurement. Also, it is necessary if those products used by patients themselves are to have an influence on performance for the patient. These arguments suggest that compliance or use of the product is added to the conceptual framework as a performance management process. Although only described in two cases, clinicians were responsible for using the CT scanner and ECG monitor in the other two cases where there was no compliance issue. The finding is found in a pattern across all relevant cases, increasing its strength.

7.5.2. Influences of the Performance Measurement and Performance Management Processes

Respondents described influences of the various processes already discussed, detailing how they can have an influence on financial, technical or customer aspects of performance. The key influences from all the cases have been used to illustrate the revised conceptual framework, as shown below. The various influences described were grouped conceptually, according to whether they had a beneficial, non-beneficial or no influence on performance. This grouping helped inform lessons for drawing a conceptual distinction between performance measurement and performance management processes, as discussed next.

Making a conceptual distinction between performance measurement processes and broader performance management processes in the empirical findings can be attempted, though it does not allow a distinct boundary to be drawn between the two, as described above.

However the empirical findings suggest it is possible to conceptually distinguish performance measurement and reporting on the one hand and performance management on the other according to their lack of influence or their influence on performance. Viewing the empirical findings in the light of the literature (such as Halachmi 2005, Bourne *et al.* 2005, Melnyk *et al.* 2005, Kaplan & Norton 1996, Neely *et al.* 1997, Robson 2005) suggests that performance measurement and reporting alone of innovative products do not have an influence on performance of the product. For there to be an influence on performance, performance management processes are also required.

So far the thesis has conceptualised performance measurement as a subset of and therefore a part of performance management (Lebas 1995). Similarly, performance reporting is suggested as a sub-set of performance management, though can be considered to be broader than performance measurement. However the finding of a non-beneficial influence for both customer and supplier where there was less performance measurement but performance management still occurred puts a focus on those parts of performance management excluding performance measurement and reporting. Returning to the literature highlighted that performance improvement is a term used by Slack *et al.* (2007 pp582-607), who discuss measuring and improving performance. As such, performance improvement refers to the non-measurement parts of their planning and control perspective of performance management.

The definitions of performance measurement and performance management given in the conceptualisation still hold, but can be updated with an additional definition of performance reporting, on the basis of the conceptual lessons. Performance measurement can still be defined as: *Quantifying or qualifying an aspect of the performance of a product*. Radnor and Barnes' (2007) definition of performance reporting *"…providing an account, and often some analysis, of the level of input, activity, or output of an event or process usually against some form of target"* is appropriate as it represents the concept with respect to performance measurement and performance management, also grouping it conceptually with performance measurement in terms of not specifying that an influence on performance occurs. With respect to performance measurement and performance reporting, performance management can still be defined as: *Broader or follow up planning and controlling action, based on information from performance measurement, which influences the performance of a product*. The definition highlights that performance management does indeed involve using information from performance measurement and performance reporting processes in broader or follow up planning and controlling action, but can be differentiated more clearly as it has an influence on performance. This definition also focuses on the performance improvement parts of performance management, which aids clarification of the distinction between performance measurement and performance reporting on the one hand and performance management on the other.

Figure 23 shows the revised conceptual framework illustrated with the processes discovered in the empirical work and the influences identified. The basic structure of the framework is the same, showing performance measurement processes and broader performance reporting processes as a subset of performance management processes that are broader still. It has been updated to show key performance measurement processes, performance reporting processes, performance management processes and influences as identified in the empirical work in the previous two chapters and discussed in the current chapter. An additional oval shows the performance reporting processes that were identified above as being distinct from performance measurement and performance management, namely dissemination of information, feedback and social and information exchange. The difference shown between performance measurement, performance reporting and performance management processes in the blue ovals is based upon their respective influences on performance (Halachmi 2005), the clearest way of distinguishing the concepts in the empirical work out of the two possible ways of drawing a difference suggested in the existing literature. Those processes shown in the measurement and reporting ovals have no influence alone on performance so are coloured the same shade of blue, however those in the performance management oval do and are coloured a lighter shade of blue. The arrow shape illustrates the types of influences discovered in the empirical work, showing beneficial, non-beneficial and no influences. Where examples of the processes are given, these are summarised from the cross case findings matrix in Appendix S, as discussed in the previous chapter.

Further to the main, revised conceptual framework, Figures 24 to 26 give diagrammatic summaries about when there is likely to be an influence on performance or not according

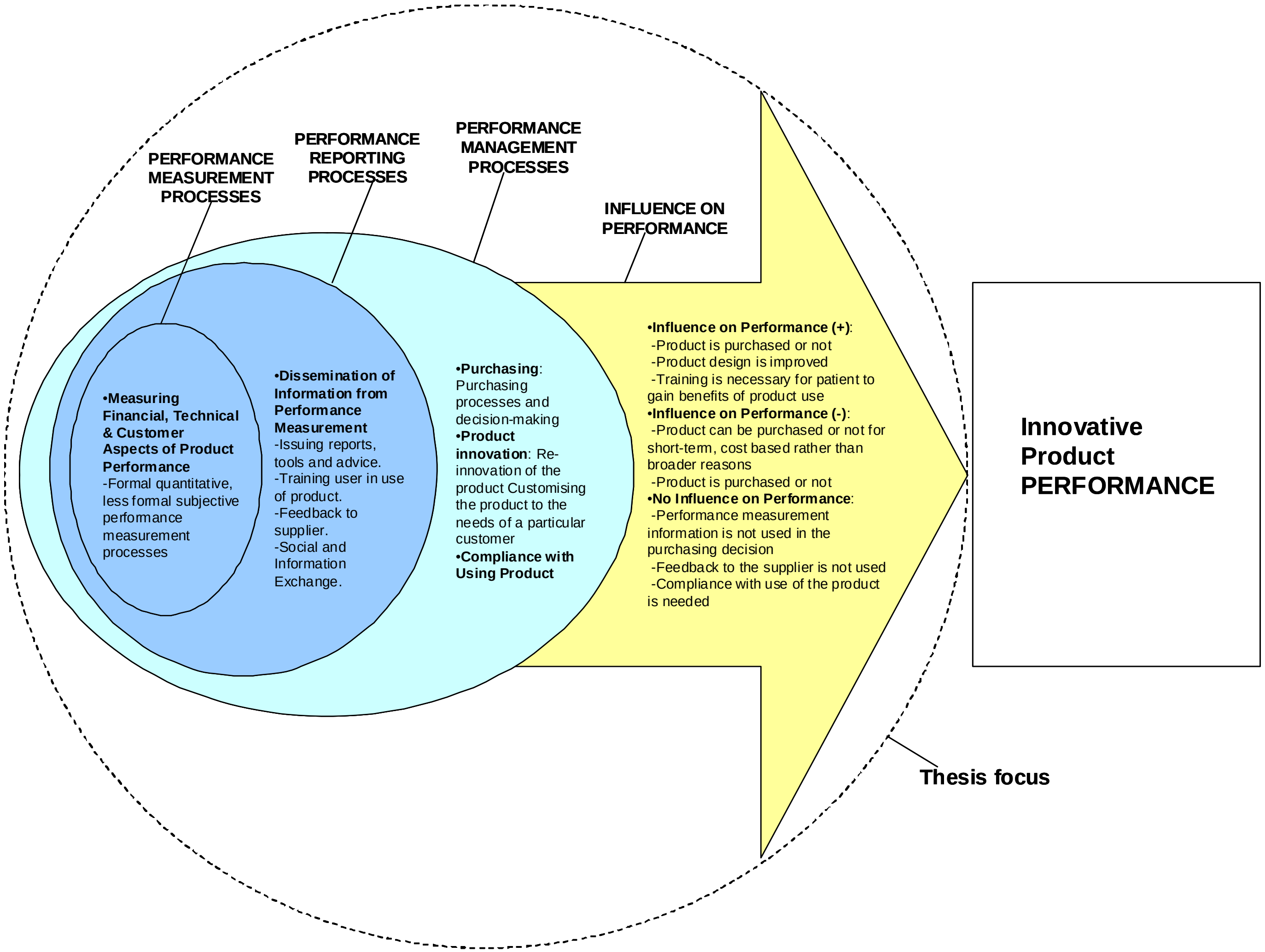

Figure 23. Revised Conceptual Framework, Illustrated from the Conceptual Findings

to whether performance measurement and performance reporting processes on the one hand and performance management processes on the other are limited or extensive.

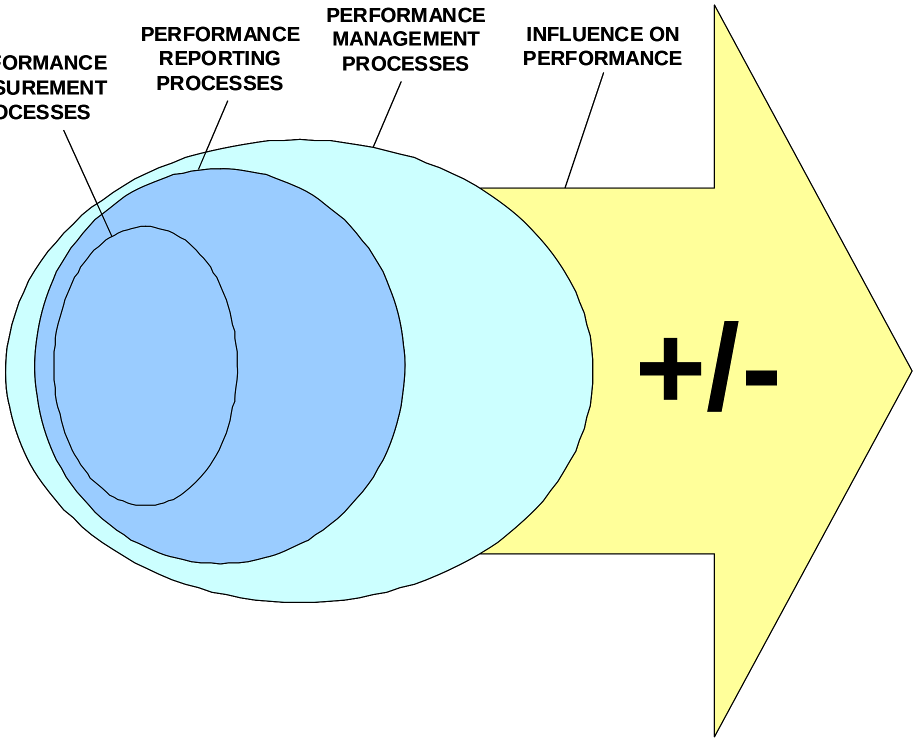

Figure 24. Conceptual Framework Illustrating Performance Measurement and Performance Reporting, as well as Performance Management Having an Influence on Performance

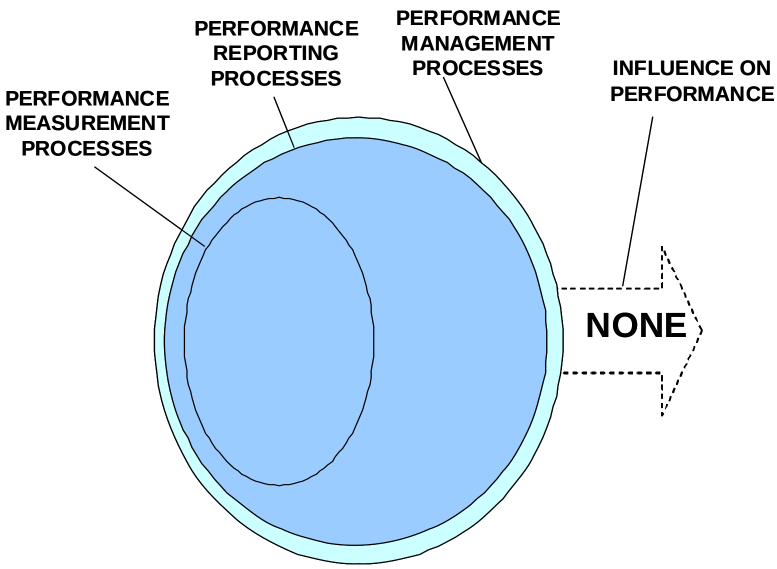

Figure 25. Modified Conceptual Framework Illustrating that No Influence on Performance Occurs When Performance Management is Limited or Does Not Occur

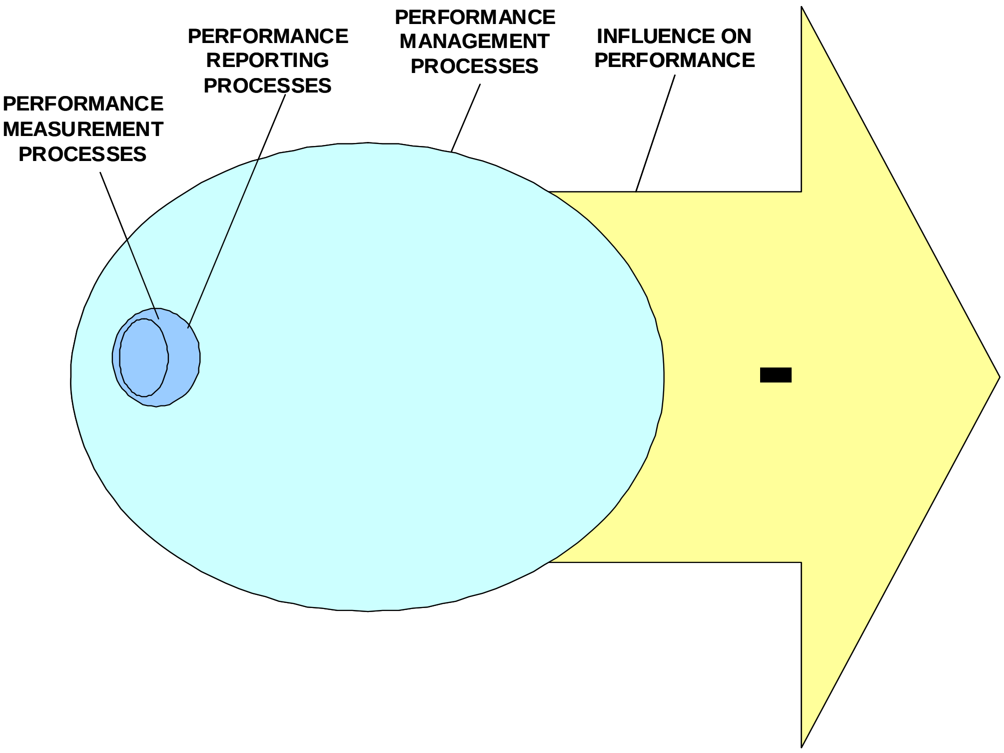

Figure 26. Modified Conceptual Framework Illustrating that a Non-beneficial Influence on Performance Occurs when Performance Measurement and Performance Reporting are Limited or Do Not Occur

From the findings and as discussed above, an influence on performance occurred where performance measurement and performance reporting, as well as broader or follow up performance management processes occur, as shown in Figure 24. The findings show that in many such examples where there was an influence it is a beneficial influence, however in some instances the influence may be beneficial for one organisational actor and non-beneficial for another. The findings also showed that when only performance measurement and performance reporting, and no performance management processes occurred, then there was no influence on performance, as represented in Figure 25. This figure shows the conceptual framework with the performance management oval reduced in size to represent no or limited performance management processes occurring, and the role arrow faded out to show that there is no role. The absolute size of the ovals compared to one another is not significant, however the reduction in size of the performance management oval compared to the original conceptual framework is used to illustrate the finding. Empirical findings showed another combination of performance measurement and reporting with performance management occurred where the influence was non-beneficial, namely where there was less performance measurement and reporting but performance management still occurred. Unlike the examples of beneficial influences above where in some instances a beneficial influence for one organisation was a non-beneficial influence for another, in this finding the influence is distinguished by always being non-beneficial for both customer and supplier organisations. A modified conceptual framework in Figure 26 is again used to show the negative influence where less performance measurement and reporting occur, but performance management still occurs.

Figures 24 to 26 illustrate the beneficial, non-beneficial and lack of influence found when more or less performance measurement and performance reporting, as well as performance management occur. A two by two matrix can be used to display the types of influences that occur when more or less of performance measurement and reporting on the one hand, and performance management on the other are found (Figure 27). The axes show limited or extensive performance measurement and reporting as well as performance management. The axes are split with those processes that do not have an influence in performance alone, namely measurement and reporting on one dimension, while the other shows performance management processes that do have an influence. The terms limited and extensive are used because, as found in the empirical data, a number of different performance measurement, reporting and management processes may be required for there to be an influence on performance. For example compliance with use as well as making the purchasing decision are two performance management processes that are required. The extensive end of the axis indicates, given the non-causal nature of the exploratory data, that more of the performance management processes needed for there to be an influence on performance have occurred. If the non-beneficial influence for both customer and supplier is to be shown, the non performance measurement and reporting part of performance management must be emphasised, so the term performance improvement is included on the vertical axis in parenthesis to state the non-performance measurement and reporting aspects of performance management, rather than viewing performance measurement and performance reporting as a subset of performance management. This enables the matrix to depict situations where performance management or improvement processes are extensive, yet use limited performance measurement and reporting.

In the top right box, extensive performance measurement and reporting as well as extensive performance management both occur, with an influence on performance. This influence is beneficial for at least one organisational actor, though in some instances may be non-beneficial for another actor. In the bottom right box, extensive performance measurement and reporting occur, but little or no performance management occurs using information from performance measurement to influence performance. In the top left box extensive performance management occurs, but on the basis of limited performance measurement and reporting, with a non-beneficial influence in performance. The matrix also shows a fourth box on the bottom left where no performance measurement, reporting and management processes occurred. No data was gathered for this box, however as no processes occurred they cannot have an influence on performance. The space in the matrix represents a control, where no influence would be expected to occur and would be a wise place to gather data for a future extension of the research to improve validity.

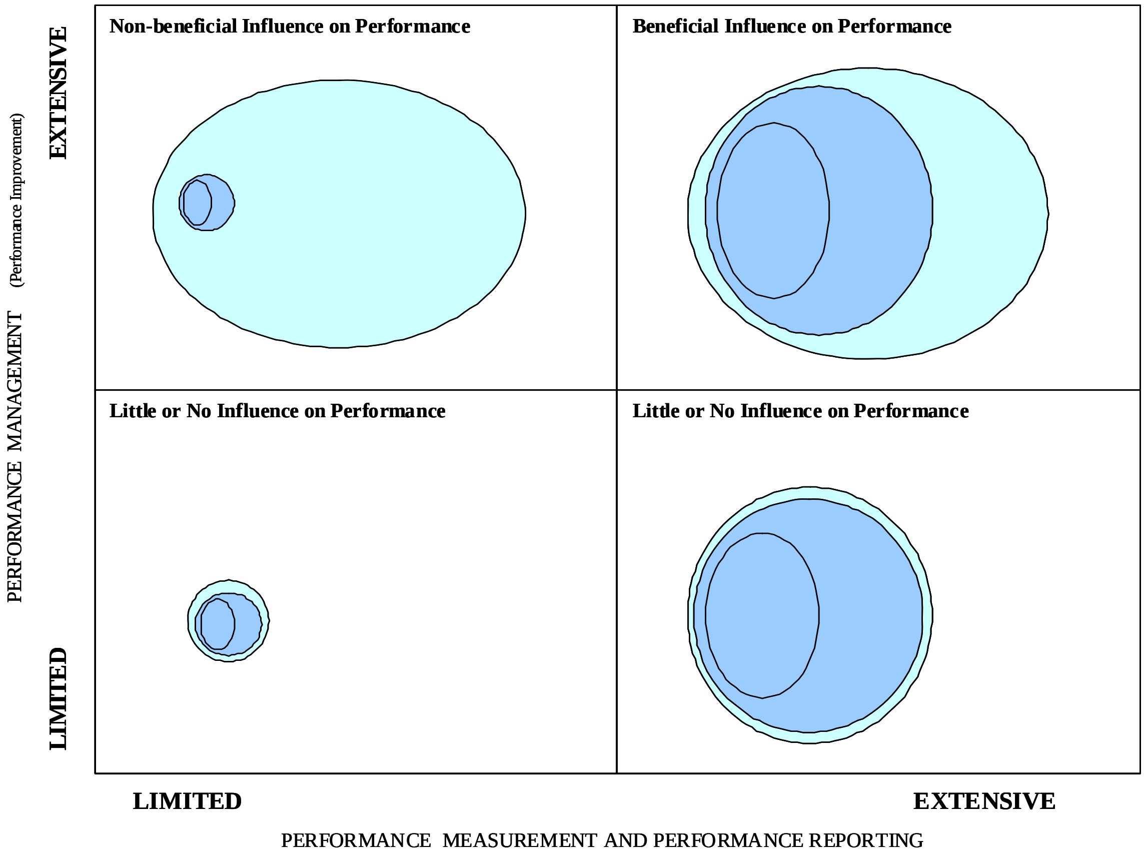

Figure 27. Matrix Illustrating Types of Influences Found With More or Less Performance Measurement, Performance Reporting and Performance Management.

Figure 28 shows the same two by two matrix, but with descriptions of the four boxes highlighting examples from the empirical work and relevant existing literature that reinforces the finding. The matrix is shown with examples from the empirical work by way of illustration, however the limitations of the research and data mean that the matrix should be used as an illustration of the conceptual lessons in the main conceptual framework, rather than a conceptual outcome in itself.

Having now discussed the empirical findings in the context of the existing literature and looked at some conceptual lessons presented by the work, the next chapter concludes the thesis by returning to the research questions, setting the outputs of this research against the context of key existing knowledge in the field that triggered the research questions. The contribution of the work, limitations and implications are then discussed in the final chapter.

PERFORMANCE MANAGEMENT (Performance Improvement)	PERFORMANCE MEASUREMENT: LIMITED	PERFORMANCE MEASUREMENT: EXTENSIVE
EXTENSIVE	**Non-beneficial Influence on Performance** **Existing Literature:** (Pfeffer & Sutton 2006, Melnyk *et al.* 2005) **Description:** Performance management processes occur, but with little or no performance measurement and reporting having occurred. There is an influence on performance, but a non-beneficial one as performance management processes do not make use of adequate information from performance measurement. **Eg:** Product can be purchased or not for short-term, cost based rather than broader reasons (4 cases) when: Performance Measurement Processes: *Measuring financial performance of the product, information dissemination*. Performance Management Processes: Making the *purchasing decision*.	**Beneficial Influence on Performance** **Existing Literature:** (Halachmi 2005, Bourne *et al.* 2005) **Description:** Performance measurement and reporting processes followed by performance management processes together have a beneficial influence on performance. **Eg:** Product purchased (4 cases) when: Performance Measurement Processes: *Measuring financial, technical, customer performance of the product, communication & social exchange between actors, information dissemination.* Performance Management Processes: *Making the purchasing decision.*
LIMITED	**Little or No Influence on Performance** **Description:** There are no processes to have an influence on performance. **Eg:** *Not observed in any of the cases.*	**Little or No Influence on Performance** **Existing Literature:** (Halachmi. 2005, Boume *et al.* 2005) **Description:** Performance measurement and reporting processes occur, but no broader or follow up performance management processes such as making a purchasing decision, or re-innovation of the product occur to influence performance. **Eg:** Performance measurement information is not used in the purchasing decision (4 cases) when: Performance Measurement Processes: *Measuring financial, technical, customer performance of the product, communication & social exchange between actors, information dissemination.* Performance Management Processes: *None.*

Figure 28. Matrix Illustrating Types of Influences Found With More or Less Performance Measurement, Performance Reporting and Performance Management, Showing Descriptions and Examples.

7.6. Summary

Discussing the findings involved returning to the literature underpinning the research, part of the iterative process that helped revise and improve the conceptual model with the benefit of the conceptual lessons identified. Although many concepts identified in the literature were also found in the empirical work, the exploratory nature of the empirical data uncovered some concepts that required investigating additional new literature. Again, research in the performance field was found to draw piecemeal on a variety of sources, with limited overall structure.

Performance measurement involved both objective and subjective measurement of a broad variety of aspects of performance as suggested by the literature. Much information was disseminated between actors and organisations following performance measurement and social informational exchange was identified as part of this dissemination, or reporting, process. Key performance management processes observed in the empirical work of making the purchasing decision, product innovation and compliance with using the product are backed up by the existing literature, which highlights how these broader or follow-up planning and control processes take action on performance measurement information so can be considered to be performance management processes.

The empirically identified influences of the performance measurement and performance management processes could be grouped a number of ways according to the existing literature. However the clearest groups were according to whether a beneficial, non-beneficial or no influence occurred. Returning to the literature reinforced empirical findings that performance measurement processes alone have little influence on performance, however an influence does occur if performance management processes occur. Evidence suggests that beneficial influences on performance occur for at least some actors if information from performance measurement processes is used in performance management processes. However performance management on the basis of little information from performance measurement has a non-beneficial influence on performance, as suggested by the evidence-based literature. These findings were presented graphically and displayed on a revised conceptual model. The additional concept of performance reporting, drawn from existing literature was fundamental in interpreting why some broader or follow up processes did not have an influence on performance. This clarified the empirical findings and rationale for differentiating performance measurement and performance management, as well as introducing a third concept of performance reporting to the revised conceptual framework. The model shows the processes explored and how although performance management processes are usually broader than or follow performance measurement and performance reporting processes, the two concepts can best be differentiated according to their influences on performance.

The next chapter continues the process of reflection by considering how the empirical research has answered the research questions, in the light of key existing work in the area that prompted the research questions.

CHAPTER EIGHT: CONCLUSIONS

8.1. Introduction

The overall conclusions of the thesis are described in this chapter. Firstly the overall research aim is revisited, then the specific research questions are revisited in the light of the research carried out. This involves returning to key existing pieces of research in the literature review that triggered the thesis. The findings of this research are concluded in the light of examining these existing works. In particular, concluding the thesis focuses on conceptualizing performance measurement and performance management, using suggestions from existing research and the empirical work to do this.

8.2. Revisiting the Research Aim

The research set out to explore how the performance of innovative products is measured and managed and whether these processes are worthwhile by having an influence on performance or not. A variety of concepts in the previous literature commenced this research interest. Firstly, the innovation literature emphasises the challenges and necessity of organisations innovating successfully (Tidd *et al.* 2005 pp37-44) and measuring performance of innovation and innovations (Tidd *et al.* 2005 pp561-569). Innovation increasingly requires taking an inter-organisational perspective (Chapman & Corso 2005, Ritter & Gemunden 2004, Grandori & Soda 1995), including a focus on purchasing and supply during implementation of the product (Biemans 1992 pp42-45) where product performance is measured. The fragmented performance literature has discussed concepts of performance measurement and increasingly focuses on performance management, with little clear difference drawn between the two (Radnor & McGuire 2004). Also, the research agenda is turning towards investigating whether performance measurement is worthwhile (Neely 2004, 1999) and the influence or impact of performance measurement on performance. In the light of these issues raised in the existing work, the overall research aim was:

- To explore performance measurement and performance management during the implementation of innovative products, focusing on their performance effects.

The research aim was addressed through a literature review, development of the conceptual framework and empirical case studies. Data from the case studies was analyzed through pattern matching against the conceptual framework, then cross-case synthesis. Following discussion of the findings, the conceptual framework has been revised as part of the iterative, abductive approach that has been taken to the research.

With respect to the research aim, the empirical findings of the thesis describe performance measurement and performance management processes during the implementation of innovative products. In particular, the findings have highlighted how the performance of medical devices, which are all examples of innovative products, is measured and managed during their implementation. These findings stand on the existing literature that emphasises the importance of innovation, especially as an inter-organisational process and measuring performance in the innovation field. Through the analysis and discussion of the findings, performance measurement and performance management processes have been differentiated, clarifying these concepts that are not clearly distinguished in the literature. To do this, the empirical findings also included information about the influences of the performance measurement and performance management processes on performance, reflecting the increasing interest in existing literature about the worth of measuring and managing performance. The concept of performance reporting emerged as a key part of understanding performance measurement and performance management concepts.

The above research aim was broken down into the research questions, which were addressed as described in the next three sections. Again, the findings of this research are examined with respect to key pieces of existing research that triggered the questions. Table 38 below summarises the response of the thesis to the research questions, positioning this against existing knowledge.

8.3. Revisiting Research Question A: *What processes are used to measure and manage the performance of innovative healthcare products during their implementation?*

Given that existing research has discussed a range of performance measurement and management processes in general (Neely *et al.* 2005) involving a variety of stakeholders and focussing on measuring a variety of aspects of performance, this first research question explored the processes that are used to measure and manage the performance of innovative products. It described how both customer and supplier organisations are involved in measuring financial, technical and customer aspects of performance. In addition to performance measurement, the literature also described broader performance management processes (Globerson 1985) involving follow up action to measurement or planning and control as suggested by Mintzberg and Lampel’s (1999) planning and control view of management. The literature review highlighted a wide variety of processes that can be considered as performance management processes. In particular, it highlighted performance management as occurring as innovation (Rothwell & Gardiner 1988) and purchasing decision making (Webster & Wind 1972 pp28-37, 89-106, Biemans 1992 p48). Further to the literature review igniting an interest in what processes are used to measure and manage the performance of innovative products during their implementation, this data about performance measurement and performance management processes occurring in practice was used for a later research question in differentiating the two concepts.

As with all the research questions, Question A was addressed through a combination of the literature review and the empirical investigation. The literature discusses performance measurement and performance management with respect to organisations, processes and products. The empirical work focussed on the product as the unit of analysis, investigating four different case studies using an instrument studying the processes and types of performance measured and managed.

Findings from the empirical work reflected some themes in existing research investigated in the initial literature review, but also exposed some less expected information about performance measurement and performance management processes. The work identified that financial, technical and customer aspects of the performance of the products are measured by various actors, reflecting the literature (Neely *et al.* 2005). Many performance measurement processes were found to be formal as suggested by the literature, such as clinical trials and tender processes. However the empirical data also highlighted informal performance measurement processes. These emphasised that subjective assessment of the performance of a product by a clinician for a particular purpose was a key performance measurement process and that much information and social exchange occurred. While less formal, subjective performance measurement processes still reflect the fundamental concept of measurement (Farbey *et al.* 1993 pp75-94), they show that performance measurement is a more diverse concept in practice than many of the quantitative, positivistic approaches emphasised in much of the existing literature (Neely *et al.* 2005). However returning to the broader literature highlighted such subjective, informal performance measurement processes by purchasing decision-makers (Zaltman *et al.* 1973 pp53-55). Subsequent review of the literature and discussion also suggested that reporting of performance measurement information, including processes such as dissemination of information, feedback, advice, training, social and informational exchange can be grouped with performance measurement, being conceptually similar. Again, many of these are less formal, more subjective processes than those suggested in much of the existing literature on performance measurement.

Taking the literature cue that performance management is broader than, or involves follow up planning and control action on performance measurement, the empirical work found a variety of performance management processes, including some of those suggested in the literature review. The processes of making the purchasing decision, re-innovation of the product and additionally compliance with use of the product were found to be key performance management processes. As highlighted in the discussion, these broad processes overarch some of the processes noticed within and across individual cases, such as different processes of decision making in group tendering and individual decision-makers, and customisation of the product for individual users. Making the purchasing decision on the basis of information from performance measurement was highlighted in the empirical work as a performance management process as it is a controlling action that is broader than or follows performance measurement and reporting. Returning to the innovation and purchasing and supply literatures also reinforced that making the decision to implement the innovative product (Biemans 1992 pp129-140) or making the purchasing decision (Zaltman *et al. ibid.*) is a broader or follow up process involving planning and control actions (Mintzberg & Lampel 1999) and so is a performance management process in the light of the performance literature (Globerson 1985).

Re-innovation was also highlighted in the empirical work and analysis as a broader or follow up management process that uses information from performance measurement and reporting in changing the design of the product, to improve its performance. This finding stands on the existing literature that discusses the importance of feedback (Globerson 1985) and a cyclical innovation process (Tidd *et al.* 2005 pp88-97), describing performance management processes. Indeed returning to the literature following data collection showed re-innovation (Rothwell & Gardiner 1985) as a concept describing this broader performance management process. They discuss how needs of the user of an innovative product have consequences for design strategy. A re-design is the outcome of user requirements, development by the supplier and even improved designs by competitors. Correspondingly, the empirical data highlighted much redesign of the product in response to gathering feedback from users or measuring performance. Returning to the innovation literature in the light of the empirical findings has highlighted that re-innovation is occurring in practice and taking the performance literature into account shows that re-innovation is a performance management process.

Further to decision-making in purchasing and re-innovation, data originally gathered on the influences of the processes for Research Question B highlighted that compliance with using the product by the customer is another key performance management process. This performance management process was not discovered through the original literature review however. Again, the process involves follow up action to performance measurement (Globerson 1985) and in the light of the performance literature is about planning and control (Mintzberg & Lampel 1999) or more specifically improving (Slack *et al.* 2007 pp582-607) the patient's condition through using the innovative product.

The conceptual framework was revised to show the key performance measurement and performance management processes identified following discussion of the empirical findings in the context of the literature, which necessitated drawing on some new sources and topics to interpret the findings. Some of the processes were identified as performance reporting processes and after discussion these were included as such in the revised framework. Together, the literature and empirical work help describe and understand the processes that are used to measure and manage the performance of innovative products during their implementation. Although the original literature review gave some background to concepts of performance measurement and performance management, the empirical data both reinforced and extended these, such as when processes identified in the innovation and purchasing and supply management literatures were viewed again in the light of the performance literature. Specifically, the findings are limited to innovative healthcare products during their implementation and this and other limitations are discussed in the next chapter, along with the contribution. The roles of the processes, the subject of Research Question B, are discussed in the next sub-section. Along with this response to Question A they also help respond to Question C below.

8.4. Revisiting Research Question B: *How do the processes used to measure and manage the performance of innovative healthcare products during their implementation influence their performance?*

This second research question investigated the influences of the performance measurement and performance management processes identified in Question A on performance of the product. As outlined in the above discussion of the overall research aim, much work so far has focussed on performance measurement on themes such as the choice of performance measures, however the literature shows an increasing interest in the worth of performance measurement and the influence or impact of performance measurement on performance. Neely (2004) highlights that a key issue for current and future research in the performance measurement field is whether performance measurement is worth it. In discussing this he describes how while exact answers cannot be given about linking performance measurement to ROI for example, there are a number of ways in which performance measurement adds value, such as providing a route map to check if objectives will be achieved, focussing minds on performance, influencing behaviour and challenging organisational strategy. In a similar vein, Bourne *et al.* (2005) discuss managing through measures, focussing upon the impact of measures on performance, again highlighting that impact of measurement systems depends on how measures are used in managing. These papers suggest that there is currently limited and conflicting evidence of the impact of performance measurement on performance (Davis & Albright 2004, Ittner *et al.* 2003, Banker *et al.* 2000, Perera *et al.* 1997, Neely *et al.* 2004). However much of this research focuses on formal measurement systems and is positivistic and quantitative in design. Kaplan and Norton (1996) echo the move in the literature towards managing through measurement systems, discussing how the BSC can be used as the cornerstone in a strategic management system, through using leading as well as lagging indicators. Indeed the original BSC publication (Kaplan & Norton 1992) refers to measures that drive performance.

Further to the interest in the worth or influence of performance measurement, the literature review exposed some papers that imply a conceptual distinction can be drawn between performance measurement and performance management as they have different influences on performance. While the work mentioned above (Davis & Albright 2004, Ittner *et al.* 2003, Banker *et al.* 2000, Perera *et al.* 1997, Neely *et al.* 2004) suggests limited and conflicting evidence about the impact of performance measurement on performance, other work has emphasised that performance measurement has behavioural (Neely *et al.* 2005) and dysfunctional consequences (Ridgway 1956). Deeper investigation in the literature review suggested that performance measurement alone cannot alter performance, but that follow up planning and control action, or performance management, is needed to do this. For example Bourne *et al.* (2005) emphasised that differences in performance occur according to how performance is managed with the measures. Hume and Wright (2006) are more blunt, stating that to deliver sustained performance improvement a performance management system is needed, not just performance monitoring. Similarly, Globerson (1985) states the importance of using feedback to respond to discrepancies between measured and desired performance, suggesting that it is performance management rather than measurement that has an influence on performance. Further, a cornerstone of Pfeffer and Sutton’s (2006) concept of evidence-based management is that evidence of performance, or information from performance measurement, is then used in follow up management action.

As before, the question was addressed through the literature review, then empirical work. The empirical work drew on this literature by exploring the influences that the particular performance measurement and performance management processes identified in Question A had in influencing different aspects of performance, then questioning respondents about any possible influences of performance measurement and performance management processes in general. The cases showed a variety of influences that the processes have and also highlighted when the processes do not have an influence.

The empirical data was analyzed, identifying that processes have influences in financial, technical and customer performance, regarding for example purchasing outcomes, the design of the product and meeting the needs of the customer. Having identified where some influences were conceptually similar, for example in relation to changing the product design, an iterative process then grouped the influences in different ways. Although there were some grounds for grouping the influences according to the type of performance they had an influence in, the clearest grouping was based on the literature suggestion that performance measurement processes do not have an influence on performance alone, performance management processes are also required (Bourne *et al.* 2005), reinforcing how the influences discovered empirically reflect the literature. Where performance measurement processes occurred alone, respondents in the cases described no influence on performance; though there was an influence where broader performance management processes (Globerson 1985, Mintzberg & Lampel 1999) occurred. However, the data raised the issue that some of these broader, follow up management processes did not have an influence on performance on their own, such as dissemination of information from performance measurement and feedback. The concept of broader processes in the literature suggests that these are performance management processes, however the empirical data shows that they do not have the influence on performance expected. Having returned to the literature and viewed these influences in the light of Radnor and Barnes’ (2007) performance reporting concept, they were grouped with performance measurement. This issue highlighted how the processes such as dissemination and feedback could not be clearly interpreted as either performance measurement or performance management in the light of existing literature, however the empirical results and revisiting the literature has clarified the concepts. Studying the influences also highlighted the importance of compliance with use of the product by the end user or patient, grouped as a further performance management process as it was described as being necessary if the other processes of performance measurement and performance management were to have an influence on performance. In describing the influences of the processes, the findings in response to question B aid clarification of the worth of performance measurement, a key issue in the existing literature as stated above (Neely 2004). Further, it places a focus on performance management as well as performance measurement, also a concern of recent performance literature (Bourne *et al.* 2005, Kaplan & Norton 1996).

Additional discoveries were made about the influences of the processes in the empirical work, which illuminate existing theory. Where processes had an influence, some of these influenced performance beneficially, others non-beneficially. Where the influence was beneficial for at least one of the customer or supplier, both performance measurement, including reporting, and performance management occurred as described above; however where the influence was non-beneficial for both customer and supplier stakeholders the empirical data suggested that although performance management occurred, it involved limited or inappropriate performance measurement and reporting. This concept was reinforced by returning to literature on the implications of cost-based versus broader measures (Ittner & Larcker 2003a, 2003b) and evidence-based management (Pfeffer & Sutton 2006). The latter emphasises the use of the best available internal and external evidence in management decision-making and the empirical findings of the thesis support this existing work, standing on it to describe evidence-based management from the point of view of concepts of performance measurement and performance management.

The empirical findings and literature work aid illustrating and understanding the influences of performance measurement and performance management processes, within the limitations of the implementation of innovative healthcare products. This builds upon questions in recent existing literature about the worth of performance measurement. Further, the empirical findings describe some of the more behavioural, less mechanistic influences of performance measurement that the literature has highlighted as important (Bourne *et al.* 2005). In describing the various influences of the performance measurement and performance management processes and indeed when there is an influence or not, the findings add some clarity and evidence to the limited and conflicting existing findings of the impact of performance measurement on performance (Davis & Albright 2004, Ittner *et al.* 2003, Banker *et al.* 2000, Perera *et al.* 1997, Neely *et al.* 2004).

The conceptual framework was updated with the benefit of analysing the empirical data in the light of returning to the literature. The processes and the beneficial, non-beneficial or no influences on performance are shown; with the distinction between performance measurement, including performance reporting, and performance management on this basis being illustrated by showing dissemination of performance measurement information as a performance measurement and reporting process. The two by two matrix in the discussion chapter was developed as a further illustration of the findings about influences of performance measurement, reporting and management. The conceptual distinction between performance measurement and performance management is discussed further in the next sub-section with respect to Question C.

8.5. Revisiting Research Question C: *How should performance measurement and performance management during the implementation of innovative healthcare products be differentiated?*

The final research question tackles a key issue identified in the review of the existing literature, namely differentiating the concepts of performance measurement and performance management. To do this it draws on the literature review and findings from the previous two research questions. Publications have highlighted that use of the two terms is conceptually loose and that they are often used interchangeably (Radnor & McGuire 2004), as found through much of the existing performance literature. Given the increasing focus on performance management as well as performance measurement in the existing literature (Kaplan & Norton 1996), clarifying the two concepts is of particular importance and interest to emerging research in the area (Radnor & McGuire *ibid.*).

Although existing research states that the distinction drawn between the two concepts is not clear, the literature review suggested two possible ways of drawing a difference. These are that performance management has been described as broader or follow up planning and control action than performance measurement, or that performance management has an influence on performance, unlike performance measurement alone.

Firstly, previous work described performance management as broader than performance measurement. Halachmi (2005) refers to performance management as: *"…a broader and more meaningful concept than simple performance measurement."*, also referring to performance measurement as a sub-system of broader performance management effort, or processes. Radnor & McGuire (2004) agree, suggesting that despite interchangeable use of the two terms, *"…performance measurement is the act of measuring the performance whereas performance management aims to react to the "outcome" measure using it in order to manage the performance"*. Elaborating, the paper argues that a performance measurement system needs to be considered in terms of broader performance management also consisting of processes, people and strategy. Lebas (1995), specifically studying performance management and performance measurement, concurs by defining the first as broader than the latter, displaying this graphically. Although Lebas (*ibid.*) states that performance measurement and performance management cannot be separated, he also states that the processes involved in each are not the same and that they feed and comfort each other, suggesting that there is indeed a difference. Further, this concept fits with the literature theme of using performance measurement systems as part of a broader process of performance management (Kaplan & Norton 1996) or improvement (Slack *et al.* 2007 pp582-607), as part of effective planning and control (Globerson 1985).

Empirical investigation occurred in response to these concurring literature suggestions that performance management is broader than performance measurement. The empirical work observed processes that meet basic definitions of performance measurement as given in the conceptualisation, drawing on Neely *et al.* (2005) and Farbey *et al.* (1993 pp75-94). It also observed many broader processes involving follow up action on information from performance measurement, as addressed in Question A. These broader processes identified in the case studies involve the performance improvement part of management planning and control actions and can be described as performance management processes in the light of the literature discussed in the previous paragraph, so the findings concurred with the existing work in this respect. The empirical work confirms Halachmi's (2005) suggestion of broader processes, which react to the outcome of the measure in order to manage performance as in the concepts described by Radnor & McGuire (2004).

However some of the empirical findings implied that the boundary between the two concepts is blurred. Lebas' (1995) conceptualisation of performance measurement and performance management is of some use here, as it discusses how the two cannot be separated and feed off each other, suggesting that they are closely intertwined. However the issue still remains that the processes in question could be defined as either performance measurement or performance management processes according to Halachmi (2005) and Radnor and McGuire (2004), as they can be considered as either a fundamental measurement process or a broader process. Usefully, Randor and Barnes' (2007) performance reporting concept provides some new clarity on the matter by introducing a third concept. This section now moves onto the second rationale from the existing literature for differentiating performance measurement and performance management.

The second explanation in the literature of how the two concepts can be differentiated suggests that performance management processes have an influence on performance through the action taken (Halachmi 2005, Bourne *et al.* 2005), whereas performance measurement processes alone do not. Halachmi (2005) explicitly draws a difference between performance measurement and performance management on this basis, stating how measurement alone is incapable of improving performance, management is also required. This is echoed by Hume & Wright (2006), as above. In contrasting the two concepts, Radnor and McGuire (2004) refer to performance management as reacting to performance measurement in order to manage performance. In line with Halachmi (2005), they again suggest that performance management, unlike performance measurement, has an influence on performance as it consists of the improvement part of management planning and control activities that can change performance. A number of other publications agree, such as Globerson (1985), Melnyk *et al.* (2005) and Kaplan and Norton (1996). This fits with the moves in the performance literature from studying performance measurement to researching performance management and the worth of measurement. Some other publications, such as Kaplan and Norton (1992) and Bourne *et al.* (2005) include discussion of the influence of performance measurement on performance, however performance management is also involved in the examples where these publications suggest measurement influences performance, for example Bourne *et al.* (*ibid.*) referring to the way management occurred with measures.

The empirical findings discussed above under Question B agree with the literature here, suggesting that performance measurement and reporting processes alone do not have an influence on performance, whereas proactive performance management processes do have an influence on performance of the innovative product. This bears out Halachmi's (2005) argument for example, as well as describing the planning and control processes of performance management more clearly in line with the increasing focus on performance management in the performance literature (Globerson 1985, Melnyk *et al.* 2005, Kaplan & Norton 1996). Also, the findings shed some light on the publications discussing the influence of performance measurement on performance, through emphasizing that performance management also occurs where there is an influence (Kaplan & Norton 1992, Bourne *et al.* 2005). As such, the thesis findings agree with and add to the suggestions in the existing literature that performance measurement and performance management can be differentiated by their influences on performance, though the current work has been more explicit than previous studies in drawing conceptual differences through pursuing the concepts, in response to question C.

When considered together, the literature and findings of the empirical work suggest that the most convincing way of describing and understanding the difference between the concepts of performance measurement and performance management can be made on the basis that the former alone does not have an influence on performance, whereas the latter does. The suggestion that performance management includes broader processes than performance measurement still holds, but is less clear cut on the boundary between the two and the analysis had to interpret the reporting processes as similar conceptually to performance measurement in the respect that neither had an influence on performance on their own to develop this conceptual lesson. Also, the discussion identified that it is specifically the performance improvement, or non measurement, parts of performance management that are needed for there to be an influence on performance. Altogether, the findings in response to question C and the revised definitions given at the end of the discussion section provide a clearer conceptualisation of performance measurement and performance management with respect to one another by building upon suggestions in the existing literature. This is in response to the key issue highlighted in the developing performance literature of a lack of clarity between the two concepts which are often used interchangeably (Radnor & McGuire 2004).

In dealing with potentially broad concepts of performance measurement and performance management, the limitations of the thesis must be remembered in addressing the research questions and assessing how the findings stand upon existing work. In particular, the response to this research question has helped understand and describe the conceptual difference between performance measurement and performance management but this understanding is limited to the implementation of innovative healthcare products, the context of this research. This limitation is discussed further in the next chapter, along with a description of the contribution of the thesis, having revisited the research questions and findings in the context of key existing literature publications in this chapter.

As a summary, Table 38 summarises how the thesis has responded to the three research questions, also highlighting how the responses of the thesis stand upon existing knowledge.

Research Question	Thesis Response to Research Question	How Response Stands on Existing Research
A: *What processes are used to measure and manage the performance of innovative healthcare products during their implementation?*	Financial, technical and customer aspects of performance are measured by various actors in formal and informal ways, often as part of the purchasing process. Performance reporting processes identified. Performance management processes identified: making the purchasing decision, re-innovation of the product and compliance with use of the product. Conceptual framework revised.	Formal performance measurement reflects fundamental concept in literature (Farbey *et al.* 1993 pp75-94, Neely *et al.* 2005), however thesis also highlights less discussed informal measurement processes (eg Zaltman *et al.* 1973 pp53-55). Existing literature describes broader or follow up processes that were identified empirically (Zaltman *et al. ibid.*, Rothwell & Gardiner 1985, Tidd *et al.* 2005 pp88-97), however performance literature (Mintzberg & Lampel 1999, Globerson 1985) presents these as performance management processes.
B: *How do the processes used to measure and manage the performance of innovative healthcare products during their implementation influence their performance?*	Processes described in A have variety of influences. Where performance measurement processes occurred alone, no influence occurred, however there was an influence where performance management processes also occurred (influence being beneficial for at least one organisational actor). A non-beneficial influence occurred with performance management, but little or no measurement. Conceptual framework revised and further two by two matrix developed.	Findings about process influences add to debate about worth of performance measurement (Neely 2004) and increasing study of managing, not just measuring, performance (Kaplan & Norton 1996). Also, findings clarify some less mechanistic and more behavioural influences, a point described as important (Bourne *et al.* 2005).
C: *How should performance measurement and performance management during the implementation of innovative healthcare products be differentiated?*	Empirical data and responses to A&B suggest that performance measurement and performance management best differentiated by their influence/lack of influence on performance. Performance management, unlike performance measurement, has an influence on performance. Conceptual framework and definitions revised.	Clarifying definitions helps resolve conceptual looseness (Radnor & McGuire 2004). Thesis builds on literature explanation that the concepts can be differentiated by their influence/lack of influence on performance (Halachmi 2005, Bourne *et al.* 2005), rather than the explanation of one being a broader or follow up process to the other (Halachmi 2005, Lebas 1995).

Table 38. Thesis Response to the Research Questions in the Light of Existing Research

8.6. Summary

This chapter returned to the research questions in the light of existing work and the empirical findings. Discussion of the findings in the context of key publications in the existing literature highlighted key performance measurement and performance management processes, as well as their influences on performance. The findings are reflected in some themes in the existing research, though some less expected findings were also made about performance measurement and performance management processes, such as the less formal, more subjective processes identified, which required broader investigation of the literature to understand. Altogether these findings about performance measurement and performance management processes as well as their influences were used to improve the conceptual framework and provide a response to the first two research questions. The additional concept of performance reporting was identified and helps answer the original research questions about performance measurement and management, as well as being a key focus for taking the work forward. The findings about the influences of the processes in performance stand on questions in the literature about the worth of performance measurement and the increasing move to studying performance management. The findings highlight some of the more behavioural, less mechanistic influences than are described in the literature and add some evidence to the limited and conflicting findings in existing work about the impact of performance measurement on performance by discussing the circumstances in which beneficial, non-beneficial or no influences occur.

Discussion of the findings from the first two research questions found a basis for differentiating the concepts of performance measurement and performance management, responding to the third research question. Of two suggestions from the existing literature about how this could be done, the suggestion that performance measurement alone does not have an influence on performance, but performance management does, is the stronger conceptually, as discussed in the previous chapter. Thus the findings and response to question C add some clarity to the issue in the literature of differentiating the two concepts, by drawing on the most appropriate of the two suggestions in the existing literature of how this might be done.

Having drawn conclusions about the findings of the thesis by returning to the research questions in the light of the existing literature, the final chapter discusses the contributions and limitations of the thesis, reflecting on the research and looking to future implications.

CHAPTER NINE: IMPLICATIONS AND REFLECTIONS

9.1. Introduction

This final chapter of the thesis begins by discussing the implications of the research, with reference to revisiting the research questions in the previous chapter. It then states the contribution of the thesis and discusses the limitations. This reflection concludes the thesis by discussing opportunities for future research.

9.2. Implications

This section reflects upon the variety of implications of the thesis, looking back at the conceptual framework, methodology, findings and conclusions. This sets the scene for a broader discussion of future research opportunities, below. Conceptual, managerial and policy implications are described in turn in the following sub-sections.

9.2.1. Conceptual Implications

The thesis has taken an iterative approach to building theory, drawing on both existing literature and the empirical work in conceptual development. This involved developing and refining a conceptual model, with implications for the concepts of performance measurement and performance management in the field of the research. These concepts were also represented in development of a two by two matrix. This sub-section describes some of the key conceptual implications, which are picked up again in stating the contribution, below. Conceptual implications are summarised in Table 39.

The thesis findings about the processes used to measure and manage the performance of innovative products have conceptual implications. Although the thesis findings identified measurement of a variety of aspects of performance as suggested in existing work, the research has clarified that performance measurement processes are not only formal and quantitative as suggested in existing literature (Farbey *et al.* 1993 pp75-94, Neely *et al.* 2005) but also less formal and subjective. Farbey *et al.*'s (*ibid.*) conceptualisation of measurement focuses on a procedure of mapping and preserving differences in attributes, while Neely *et al.* (*ibid.*) define measurement as involving quantification. In contrast the thesis has discussed findings of performance measurement that focus on subjective assessment of an innovative product by a clinician for example, including through communication with other actors. The finding about less formal and subjective measurement processes implies a broader concept of performance measurement than is found in much of the existing literature, suggesting that future research is required to investigate these less formal and more subjective aspects of performance measurement. The concept of performance measurement could then be revised and expanded, with implications for the underlying concepts and definitions used in future research on performance measurement. In discussing performance measurement and performance management, performance reporting was also identified as a key concept. It is grouped with performance measurement in this research as it is similar conceptually in terms of a lack of influence on performance, however the concept has had implications for the findings about performance measurement and management, as well as for future research.

Conceptual Findings of Thesis	**Conceptual Basis in Existing Literature**	**Conceptual Implications of Thesis**
Performance measurement processes: Involve measuring financial, technical and customer aspects and dissemination of information. Are not only formal and quantitative but also less formal and subjective. Performance reporting is also a key concept.	Describes measurement of a variety of aspects of performance (Kaplan & Norton 1992). Focuses on formal and quantitative concepts of performance measurement (Farbey *et al.* 1993 pp75-94, Neely *et al.* 2005). Performance reporting (Radnor & Barnes 2007)	Broader concept of performance measurement than in much of the existing literature has implications for underlying concepts of performance measurement. Performance reporting concept identified as important.
Concept of performance management involves: -Purchasing -Product innovation -Compliance with using the product	Performance management is a loose concept in the existing literature (Radnor & McGuire 2004).	Thesis adds clarity to the loose concept of performance management by suggesting new definitions, stating the strongest basis for differentiating performance measurement from performance management.
Discovered a variety of influences of the above processes on performance. Influences of processes were found to group most clearly depending on amount of measurement and/or management: -Beneficial -Non-beneficial -None	Increasing interest in performance management rather than just performance measurement (Kaplan & Norton 1996) and a focus on the worth of performance measurement (Bourne *et al.* 2005). Existing work has focussed on mechanistic, positivistic links to performance.	Thesis adds to existing research on how performance measurement and performance management processes have an influence on performance, highlights the importance of both occurring. This is a basis for further research on the worth of both performance measurement and management processes together. Thesis has focussed on less mechanistic and more behavioural influences.
Thesis differentiates performance measurement processes from performance management processes on basis of their respective lack of influence, or influence on performance.	There is little clear distinction between the two concepts (Radnor & McGuire 2004). Performance management could be differentiated from performance measurement as it: -Involves broader or follow up processes (Halachmi 2005, Lebas 1995), or: -Has an influence on performance which performance measurement does not (Halachmi 2005, Bourne *et al.* 2005).	Best basis for differentiating the two concepts is their respective influence or lack of influence on performance. Future research can be based on clearer definitions and avoid interchangeable use of terms.

Table 39. Summary of Conceptual Implications of the Thesis

The findings of this research about performance management processes add to understanding the loose concept of performance management in the existing literature. Further to existing work describing performance management as involving broader or follow up planning and control (Mintzberg & Lampel 1999) processes than performance measurement (Halachmi 2005, Lebas 1995), the thesis findings described performance management as involving purchasing, product innovation and compliance with using the product, as shown on the conceptual framework. As such, the thesis illustrates the concept of performance management in more detail than in the broad and loose description in the existing literature. Having returned to the innovation and purchasing and supply literatures, the findings imply that concepts from those fields, such as re-innovation (Rothwell & Gardiner 1985) and purchasing decision-making (Zaltman *et al.* 1973 pp53-55) require attention in future academic work on performance management. Overall, the variety of performance management processes that were identified in the empirical work highlight the breadth and depth of the performance management concept. Future research that is based on definitions or concepts of performance management can look to this research to give a clearer definition of the concept of performance management. Given that performance management is described in existing literature as a loose concept that is frequently used interchangeably with performance measurement, these findings about the nature of performance management help provide a distinction between the two concepts, as described in more detail below.

In discovering a variety of influences of the performance measurement and performance management processes described above, the thesis explored a conceptual topic that has been of increasing interest in the existing literature. Kaplan and Norton (1996) highlights the move from studying performance measurement to performance management, while Bourne *et al.* (2005) emphasises an increasing focus on researching the worth of performance measurement. Whereas Bourne *et al.* state that existing work has focussed on mechanistic links between processes and performance using quantitative, positivistic methods, the thesis has focussed on less mechanistic and more behavioural influences than in much existing work. For example the thesis has established some understanding about the influences of the processes in purchasing outcomes, the design of the product and meeting the needs of the customer. This has provided an understanding about the influences of the processes which is appropriate for exploratory conceptual development work, rather than a causal study of mechanistic impact on performance. By revealing that performance measurement and management processes together had a beneficial influence on performance, that performance management with limited measurement had a non-beneficial influence on performance and that performance measurement alone had no influence; the thesis has conceptually illustrated the influences of the processes. The thesis has emphasised the conceptual importance of both performance measurement and management occurring, a basis for further research in future investigating when and how they are most worthwhile.

Overall, the thesis has clarified concepts of performance measurement and performance management by drawing a difference between them on the basis of their influence or otherwise on performance, giving new definitions of the concepts as shown in the discussion. Extant literature (Radnor & McGuire 2004) highlighted that there is little clear conceptual distinction between performance measurement and performance management, the terms often being used interchangeably. The literature suggested two possible conceptual bases for differentiating between performance measurement and performance management, namely that the latter involves broader or follow up processes (Halachmi 2005, Lebas 1995) or as the latter has an influence on performance which performance measurement does not (Halachmi 2005, Bourne *et al.* 2005). The thesis used empirical findings to demonstrate that the two terms can best be distinguished on the basis of their influence, or lack of influence, on performance. This finding clarifies key concepts in the performance literature by differentiating the concepts and describing the basis for doing so. Given the points just made, the conceptual implication for research in the field is that performance measurement and performance management are more clearly defined as the basis for future research which is based on concepts of performance measurement and performance management. Indeed, interchangeable use of the terms as in past research can be avoided. Further, the increasing moves in the literature towards studying performance management rather than just measurement (Kaplan & Norton 1996) and focussing on the worth of performance measurement (Bourne *et al.* 2005) is underpinned by clearer definitions of the basic concepts, as discussed above. The conceptual implications of the thesis could assist future research in assessing the worth of performance measurement and performance management processes, and investigate more deeply their behavioural implications and causal links to changing performance.

In discussing these conceptual implications for future research, the limitations of this research should be borne in mind, which are described in more detail below. The conceptual developments of the thesis that are discussed in this sub-section also have managerial implications, as discussed in the next sub-section.

9.2.2. Managerial Implications

The thesis has been an academic project, so has concentrated on the development of a research project and contribution, rather than normative findings for practitioners. Now that the research process has been described, discussed and conclusions drawn, it is worthwhile to identify some key implications of the study for managerial practitioners, in line with the ‘double hurdle test’ of academic rigour and practical relevance (Tranfield & Starkey 1998 p353).

The processes shown in the conceptual framework and discussed in the thesis describe different ways in which individuals and organisations can measure, report and manage performance. Notwithstanding limitations to the context of the cases and in developing the processes in the empirical work, they could be used as a checklist of generic ideas for practitioners who wish to ensure that they are measuring performance in appropriate ways and taking proactive improvement action on performance measures. Further, they demonstrate that performance measurement and management do not always have to be quantitative, systematic processes as some literature would suggest. Given the focus in the existing literature on appropriate selection and implementation of performance measures (Neely *et al.* 1997), this research implies that managers should be aware of the possibility that performance can be measured through communicating with others and making informal assessments as well as through more formal traditional systems. In an organisation as large as the NHS the current study opens the eyes of managers to what actually goes on at the local level and in the multitude of constituent organisations, such as informal, subjective performance measurement. Also, the study emphasises that a wide variety of aspects of performance should be measured in practice, a point of interest to practitioners such as CEP who are trying to broaden the aspects of performance that they report upon and are looking for methods to achieve this.

The literature and empirical work both reinforce the importance for practitioners of looking beyond the boundaries of their own organisation and actions when procuring, innovating, measuring or managing performance. For example, there was widespread exchange of performance measurement information between actors who measured performance through social exchange and who disseminated and fed back information from their own performance measurement processes. Further, the performance measurement and performance management processes identified usually involved more than one organisation or actor, echoing the point in the literature about how innovation must involve more than one organisation for success (Ritter & Gemunden 2004, Chapman & Corso 2005, Grandori & Soda 1995). Overall, the implication for practice is that managers must endeavour to look and work beyond their own organisation when managing performance. Established social science research tools such as drawing network pictures (Oberg *et al.* 2007) and constructing matrices (Miles & Huberman 1983 pp151-189) may help the practitioner in appreciating and reconciling the activities of different stakeholders.

The influences of the performance measurement and reporting, as well as performance management processes provide a key implication for practitioners. Much research and many respondents described how practitioners measure and report performance, yet there is limited appreciation that these processes have no influence on performance without taking some sort of management action to improve performance. Hume and Wright's (2006) analogy expresses the point neatly for practitioners: *"You don't make a pig fatter by weighing it"*. In other words if practitioners want to influence performance, measurement and reporting are not worthwhile unless management action is also taken. Also the findings emphasise the importance of ensuring sufficiently broad performance measurement occurs as well as performance management. The two by two matrix illustrates the implication that managers must ensure that extensive performance measurement or performance management both occur if they wish their efforts to have a beneficial influence on performance.

Drawing a conceptual difference between the terms 'performance measurement' and 'performance management' is predominantly an exercise of academic interest, however the difference drawn had implications for whether certain processes carried out by individuals and organisations were worthwhile. The distinction can help practitioners realise the importance of follow up management action if they wish to improve performance.

Figures 27 and 28 in the discussion chapter showing when performance measurement and performance management processes do and do not have an influence on performance is a useful tool for managers in practice. They provide a visual reference and describe examples of the processes that should be implemented for effective performance measurement and management, in the top right corner of the matrix for example. The matrix could be used by managers to check performance measurement and management processes for a particular innovative product or even their organisation against those in the matrix, then positioning it in the matrix. When compared with the desired position in the top right of the matrix where there is most beneficial influence on performance, the manager can then implement processes shown to close the gap between the current and desired status of performance measurement and performance management for the innovative product. Although the matrix is currently presented from the point of view of an academic concept, it could be operationalised for managers through a series of questions based on the interview guide and literature review that are used to position the status of performance measurement and performance management on the axes. The example processes in the boxes could also be expanded to include all examples from the revised conceptual framework in a fully developed applied tool.

In addition to the managerial implications, policy implications are drawn out in the next sub-section.

9.2.3. Policy Implications

Further to the managerial implications, the thesis has implications for policy, given the setting in the public sector context. The managerial implications above are of relevance for determining policy about management practice in the public sector, though the thesis could have broader implications for policy making in the fields of performance, purchasing and supply management and innovation, particularly in the context of the relevant UK Government policy documents as discussed in the literature review. Overall the thesis implies that policy making in the field of managing the purchasing and supply of innovative products should focus not only on performance measurement but also on performance management.

Recent policy documents have focussed on gaining efficiencies through procurement (Gershon 2004 pp5-8, 35-36, Bourne 2006 pp2-11, H.M. Treasury 2007 p3), placing a focus on measuring financial performance. However the documents also place an emphasis on evidence-based policy as a lever for improving performance (Gershon *ibid.*) reinforcing the policy implication of the thesis that both performance measurement and performance management are necessary to improve performance. It is interesting to note that Bourn (2006 pp2-11) discusses how measurement of financial performance and savings has occurred, but there is doubt over the £4.7bn savings, describing how verification of this aspect of performance is necessary. The issue suggests that either performance measurement and reporting have been insufficient, or that more follow up performance management is also required.

The thesis findings also imply support for the HITF recommendations (2004 pp5-7) supported by other policy documents (DTI 2003 pp7-16, Cooksey 2006 pp3-8) about encouraging innovation through procurement and the setting up of CEP. Measuring a broad variety of aspects of performance as intended by CEP is wise, while the approach of evidence-based purchasing relies on both performance measurement and subsequent performance management as advocated by the thesis findings. However the case studies suggest that CEP is measuring performance through the evaluation centres and reporting it, but that the information is not always used in follow up management by purchasing and innovating actors in the networks. The thesis findings imply that policy should focus on ensuring that CEP performance measurement outputs are used by purchasers in the NHS, as well as by suppliers to re-innovate their products.

Public policy has encouraged innovation (HITF 2004 pp5-7, DTI 2003 pp7-16), however the thesis implies that encouraging re-innovation, given the incrementally innovative nature of the products is important. This implies that policy should focus on the public sector aiding suppliers to re-innovate their products through the provision of appropriate feedback information from performance measurement and possible incentives for suppliers to improve the design of the product by longer term purchasing agreements, or more dynamic evaluations that recognise that innovative products keep improving. For example the ECG monitor supplier expressed frustration that technical evaluation of the product by CEP only took a snapshot in time of the product’s performance, ignoring improvements made in response to the evaluation.

Finding that compliance with use of the product was a performance management process has the implication that the public sector should focus on policy making that promotes compliance with use of products, as well as appropriate purchasing and innovation practices. Only then will the innovative product perform for the user by improving their healthcare. Policy could promote working with suppliers to distribute guidelines and advice on use such as those produced by the blood glucose meter supplier, centralised training to ensure that the many local level users in the NHS are using the product appropriately and running campaigns to ensure patients use the product as intended.

Having discussed a variety of implications of the thesis and previously concluded the thesis through reviewing the research questions, the next section of this chapter continues by stating the contribution of the thesis.

9.3. Contribution

In general terms, the thesis has contributed to understanding performance measurement and management processes and their influence, with respect to innovative products. In particular, the contribution concerns clarifying the concepts of performance measurement and performance management, describing when they are worthwhile and have an influence on performance. The contribution is made in the context of the implementation of innovative healthcare products.

The research has explored processes of performance measurement and performance management in the implementation of innovative healthcare products, identifying key processes that occur. In addition to the formal, quantitative performance measurement processes in the literature, the research has identified less formal subjective processes involving social and information exchange in assessing financial, technical and customer aspects of performance. Performance reporting was also identified as a concept closely associated with performance measurement. The research has also identified purchasing, product innovation and compliance with use of the product as key performance management processes, shedding some light on the performance improvement part of the broader or follow up planning and control actions that are suggested as performance management in the literature.

The thesis has contributed to the emerging debate in the literature about whether performance measurement and performance management processes are worthwhile by their having a role in influencing performance. The findings give indications that performance measurement and reporting alone cannot be expected to have an influence on performance, however if performance management processes occur too then they can be expected to have an influence on performance of the innovative healthcare product. Also, sufficient performance measurement and reporting was found to be necessary if performance management is to have a beneficial influence on performance. The two by two matrix is a conceptual contribution demonstrating the beneficial, non-beneficial and lack of influences on performance that occur with limited or extensive performance measurement and performance management.

Taken together, the findings have contributed to understanding how concepts of performance measurement and performance management of the innovative healthcare product during its implementation can be differentiated, by looking at their influence on performance. The thesis suggests that performance measurement and reporting are processes that do not have an influence on performance alone, but do when broader performance management processes, of which they are a subset, also occur.

The research has some important limitations, which must be born in mind when considering the contribution. These limitations are discussed in the next section.

9.4. Limitations

A key part of presenting the contribution of the study is to understand the limitations of the contribution. The thesis has conceptual and methodological limitations, as well as limitations of the findings. These are discussed below, including an outline of the limitations to the validity and reliability of the study.

A core lesson from the PhD is the imperative of taking an iterative, reflective approach to the process, which ultimately results in better research. Another key learning experience in the early days was that the scope of the research and contribution must be modest and that there are likely to be many limitations. These lessons have helped the author develop as a researcher and have implications for the possible future of the research, as well as potentially pursuing other opportunities for research in the future, described below.

Most immediately, the limitations of this research have highlighted ways it would be best to continue and improve the research. Retrospect is a powerful lens and highlights the value of the learning experience, so priorities in continuing the research would be to improve the design of the research with the benefit of hindsight and the iterative learning process, with the benefit of improving rigour. Having had the input of the empirical work and discussion in the light of the literature, the concepts in the conceptual framework are sounder than those drawn from the original literature review. Additionally, the new two by two matrix gives a new conceptual representation of performance measurement and management processes and their influence on performance. There is an opportunity for further research based on a more rigorous conceptual framework or the new two by to matrix, constructed with the benefit of this research and further literature review. For example the concepts of performance reporting and of performance improvement warrant deeper investigation in the next phase of the research. Limitations of the analysis process and software in the thesis imply that it would be wise to pursue any continuation of the research by using a more widely recognised software package such as NVivo and full transcription.

A limitation of this research was the restricted ability to take account of contextual issues in the cases, a limitation found also in other recent research in the field (Bourne *et al.* 2005). There is an opportunity for future research that either controls for contextual issues by pursuing different cases within and outside the NHS context, or studies the role of that context. Further, the discussions and limitations suggested that increasing the number of cases would not only improve the analytical generalisability, but the selection of contrasting cases would provide opportunities to explore more rival explanations for the findings about the NHS context and the individual aspects of the different products and suppliers involved in the cases.

9.4.1. Key Limitations

Firstly, the thesis is limited to the context of the empirical research, namely the implementation of innovative healthcare products. The broad concepts in the performance literature suggest that it could be possible to generalise the findings to other types of innovative products, or even beyond to the performance measurement and management of projects or organisations themselves. However, the focus of the empirical case studies suggests that additional case studies would be required in broader contexts, to develop analytic generalisability of the findings using a replication logic (Yin 2003 pp31-33).

The empirical work used a multiple case study design to enable replication of findings across cases, improving the analytical generalisability of the work. Using four cases, the analysis was able to demonstrate some amount of analytical generalisability, however a greater number of cases would have been advantageous to expose the findings to greater scrutiny and open up the possibility of improving further analytical generalisability. In particular, the individual cases mainly produced similar findings, so the selection of extreme or outlier cases to test rival theories in the analysis was often challenging, though all the empirical evidence was attended to. Although each case had particular themes, none of the four was very different from the others. The similar findings across all four cases mean that the findings cannot be generalised to a context other than that chosen in this thesis. Nonetheless, differences in the individual aspects of the cases, such as the size of the supplier organisation mean that the basis for replication across similar cases can be challenged and represent another limitation, despite the use of screening questions. While some differences between cases were drawn, such as whether the product was used by a clinician or end user, gathering greater amounts of scoping data for each case at the outset would have reduced this limitation.

Adopting the innovative product as unit of analysis was a decision made after the initial literature review and discussions with practitioners, given that innovation is inherently an inter-organisational process and that many respondents inherently focussed their responses on products. However a large amount of work in the performance and innovation literatures concentrates on the organisation as a unit of analysis, presenting the challenge of finding existing work with the same unit of analysis that is directly relevant to the current work. Thus the findings were by necessity based in part on generic concepts of performance measurement and management, rather than performance measurement and management of innovative products.

Further, the research highlights that it is difficult to empirically investigate performance measurement and performance management of a particular innovative healthcare product without understanding the broader context of the network of organisations involved. The empirical work sought to acknowledge this issue by interviewing stakeholder respondents from a variety of organisations, however the size and complexity of the networks involved mean that the research was limited in ability to consider the role of the broader context of organisations, relationships and networks in analysis. This meant that the research was limited by not being able to check out rival explanations for the findings on the basis that the context was having some sort of role in performance, for example. By choosing cases of products that are all supplied to the NHS, many aspects of the context of the products and processes studied are kept constant, as has been attempted in previous research which studied processes in different business units within the same organisation (Bourne *et al.* 2005). However the similar nature of the cases meant that limited contrasts could be drawn within the context, as discussed above. The dynamic nature of the healthcare context, and the NHS organisations at the national and regional levels in particular mean that the findings of the empirical work are also limited to the particular temporal cross section, as organisations and therefore processes may have evolved since. For example the rise of evidence-based medicine and the Centre of Evidence-based Purchasing suggests there may be pressure in future to reduce the number of clinicians who measure product performance in subjective ways based on their own internal experience, a finding of the empirical work. Validation of the case study descriptions by key Evaluation Centre and PASA respondents suggested that their more recent output reports following the CEP change programme may be more useful to buyers. However analysis in this research was limited to focussing on cross sectional data gathered before many new CEP and Evaluation Centre outputs had been fully introduced.

Another limitation concerns how the conceptualisation explored the influences of the processes, rather than studying conclusive links to performance. The research was carried out in this way due to the limited existing literature in the area, making a more conclusive study less appropriate, however in future such a study would provide a more thorough understanding of actual effects on performance. There were also difficulties operationalizing some aspects of the conceptual framework, for example the roles of the performance measurement and performance management processes in performance. Although the research design was exploratory and iterative, many roles only became clear throughout the empirical work and analysis, suggesting that more operationalisation of the concepts in the conceptual framework would have been useful to gain a clearer understanding when the research turned to the empirical work. The abductive research approach proved useful in combining the findings of the literature review and empirical work in a process of iterative learning, though it was challenging to improve the conceptual structure as suggested, because the literature is developing rapidly and still not clear in the area of performance measurement and management processes. This meant that interpretations of the empirical findings and the return to the literature following the empirical work played a large role in revising the conceptual framework, compared to the initial literature review.

The performance measurement and performance management processes shown at the centre of the conceptual framework were based on the empirical findings, reinforced by their examination in the context of the literature and highlight how the processes occur. They also helped provide the basis for the discussions of drawing a conceptual distinction between performance measurement and performance management. However the processes described are generic and may not be applicable to particular product case studies. The qualitative nature of many of the processes found, such as social exchange for example, made it difficult to determine whether important aspects of the processes were missing or included in the descriptions given in the conceptual framework so the research cannot describe a conclusive, complete or final set of processes.

Analysis of the empirical data used HyperRESEARCH, a relatively recent and lesser known software package than widespread NVivo for example. Various versions of HyperRESEARCH have been used successfully in recent social science research (Lewis *et al.* 2004, Ngwenyama & Sullivan 2007), including research on organisations that used interview methods (Eversole *et al.* 2007). Using the programme has had benefits for the validity, reliability and generalisability of the analysis (Hesse-Biber *et al.* 1991), as well as challenging the researcher conceptually (Staller 2002). It was found to be particularly useful for analysing the mood and feeling of respondents when coding as their voice could be heard, giving a direct link to original data, though the coding process required long periods of time to repeatedly listen to the same file. However, the lack of complete written transcripts as used in NVivo is unusual when compared to much contemporary qualitative analysis and could be perceived as a limitation of the research, given that the audit trail for the analysis instead relies on the raw sound files, HyperResearch project files, the various matrices and additional notes made at the interviews.

The analytic strategy set out to gather evidence from both semi-structured interviews and supplementary documentary evidence with the aim of triangulating between them. While some documentary evidence was available to back up the data from the interviews, the amount of documentary evidence was limited, particularly given the qualitative, subjective nature of many of the performance measurement processes described by interview respondents, for example. Harder, quantitative processes such as tender processes are described in better detail in the literature, though also presented limited documentary evidence as respondents rarely wanted to reveal commercially sensitive information outside an interview discussion. The limitations regarding documentary evidence meant that the analysis drew more heavily on the interview data and existing literature when attempting to triangulate data than would have been preferred if sufficient documentary evidence had been available.

Given that the literature on performance measurement and management is new and developing, the research had to draw on literature from several different topics and areas of theory. Drawing on different areas of theory mean that the research is widely informed, however it presented issues of how to reconcile the varying concepts of performance, for example between quantitative, financial aspects of performance in the economics literature and more subjective aspects elsewhere. The study is also limited by the limitations of each of the areas of literature that it draws upon, for example the loose nature and lack of conceptual clarity in much of the performance literature and the challenges of researching complex relationships and networks in the purchasing and supply and innovation literatures, the latter as innovation is an inter-organisational process.

Seeing that much research in the performance field is emergent, research with exploratory aspects could potentially be criticised as being tautological and of limited worth if it makes key findings that are closely related to the existing literature the study draws on, it being inevitable that outcomes of the research would be a particular finding. For example, the criticism could possibly be levelled at the finding that a key performance management process involves innovation, when the research drew on innovation process literature. However the loose structure of many questions in the interview guide encouraged respondents to give open answers that were not just related to the underlying literature and the serendipitous findings of unexpected performance management processes, such as compliance with use of the product, reinforce this. Further, the thesis drew on a variety of different literature topics for breadth, tested different theories about how the conceptual difference between performance measurement and performance management could be drawn and later drew on new literature in the discussion to interpret the empirical work.

9.4.2. Outline of Limitations to Validity & Reliability

As described in the methodology, attempts were made to encourage a valid and reliable study. However the key limitations above highlight the limitations to the validity and reliability, which are summarised as follows.

Construct Validity

Although the operational measures were based on the initial literature review, multiple sources of evidence were used, effort was made to establish a chain of evidence and the work was reviewed by respondents and other researchers as shown in the Appendix; there were some limits to construct validity. Restrictions in the original literature on which the study was based, limited documentary evidence available and limitations of HyperResearch compared to NVivo present various limitations.

Internal Validity

The empirical work improved after expediting the CT scanner case as a pilot case and the research was able to test some rival explanations, however the fairly similar findings of all the cases suggest that outlier or extreme cases would have been useful to reduce the limitations of internal validity and provided some more challenging rival explanations to test. Discussing the interview guide and findings with fellow researchers assisted internal validity however.

External Validity

Despite comparing empirical findings across multiple cases and with the existing literature, the research has limited analytical generalisability beyond the context of this research due to the similar nature of the existing case contexts and the particular organisational context of the dynamic NHS. Additional and extreme cases in other contexts, as suggested above, would help improve external validity.

Reliability

Discussions with research participants and other researchers aided reliability of the project, as did a test of the data by another researcher and the use of HyperResearch, however the limitations of the software mean that NVivo may be perceived as more helpful to ensuring reliability to some researchers.

Having described key limitations of the thesis and current research, the next section discusses opportunities for future research, including extensions to the research that could reduce some of these limitations.

9.5. Future Research

Researching a focused PhD thesis has also developed an appreciation of the large number of broader future opportunities for research that could be pursued, dependent upon building a publication record, time and resources.

The thesis focussed on innovative healthcare products as a unit of analysis, however it would be interesting to carry out further cases to see if the findings could be generalised to pharmaceuticals for example, or innovative products in other sectors. Indeed, there is the opportunity of generalising the findings of the research using different units of analysis, studying the performance measurement and management of organisations, projects, relationships or product portfolios for example. Much existing performance literature and seminal work in the area concentrates on the organisation (Neely *et al.* 2005, Kaplan & Norton 1992), rather than the product, so future research with the organisation as unit of analysis will be key to externally validating the findings to generic concepts of performance measurement and performance management. Given the inherent role of purchasing and supply management in the innovation process, the emerging interest in the performance of supply relationships in the literature (Lamming *et al.* 1996, Johnsen *et al.* 2008) is an opportunity for future research.

The evidence-based literature is receiving increasing interest and the concept has grown dramatically during the time of this research. Evidence-based issues share some conceptual similarity with performance measurement issues in the literature and helped in the literature review and conceptual discussions of this research. The nascent concept of evidence-based purchasing is likely to be a key theme of future research, investigating what evidence-based purchasing is, what might constitute evidence and the role of evidence-based purchasing in achieving public policy objectives (Harland *et al.* 2007). Performance reporting (Radnor & Barnes 2007) was also discovered as a key concept deserving of future research. Further, the performance improvement part of performance management will also require additional research when studying evidence-based issues. This field of future research also raises the issue of defining value, a concept that has similarities to performance. There is an opportunity for further research in defining the concept of value or performance, in the performance field in general and with respect to the purchasing of innovations in particular, the latter being demanding of further research as multiple stakeholders are involved who are likely to have different perceptions of value.

There is also the need for future research using a different research design and methods. Given the nature of existing research in the field, this research has had a strong exploratory element; however in the longer-term as the field develops there may be the opportunity for more conclusive research designs. Software such as HyperResearch and NVivo have a variety of powerful tools for modelling and testing hypotheses that were beyond the scope of the current study, but could add value in the future if the research design deemed their use appropriate to understand the field more conclusively as it develops. More conclusive research in the future could involve studying the actual effects of performance measurement and performance management processes on performance; rather than the processes themselves and their influences as is the current focus in the field. Also in the longer term, a longitudinal study is an ambition that would shed valuable light on the processes observed in this cross-sectional research, given the dynamic nature of the NHS, innovation and purchasing in practice. For example, respondents validating the case descriptions suggested the CEP change programme was producing more influential evaluation outputs and reports, which could be investigated in a longitudinal study, unlike the current cross-sectional one.

9.6. Summary

This chapter concluded the thesis by discussing the implications, contribution and limitations of the thesis, before describing opportunities for future research.

On reflection the overarching point emphasised is the learning process of carrying out PhD research and the development of the author as a researcher. A key strength of the thesis is that it has implications for academic theory by exploring and differentiating concepts which were identified as key issues in the existing literature. The thesis also has implications for managers by highlighting processes that can be used to measure and manage performance and when these processes are worthwhile, meeting a key practical concern. Additionally, the thesis has implications for policy makers in the fields of performance, purchasing and supply and innovation, given the recent focus on encouraging uptake of innovations by the NHS and making efficiencies through purchasing. When reviewing decisions made over the course of the research, retrospect can seem all too powerful, however it is from such learning experiences that the iterative research process has developed a contribution, within stated limitations.

In line with answering the research questions, overall the contribution of the thesis is in understanding performance measurement processes, performance management processes and their influence. Especially, the thesis has clarified the concepts and described when performance measurement and management are worthwhile, key areas of concern highlighted in existing research. The contribution is made in, and limited to, the context of the implementation of innovative healthcare products. Further limitations to the research were discussed, about the focus of the research, unit of analysis and the methodology selected, with consequences for reliability and validity. Further, the complex nature of the subject of study in the public sector and the restricted, piecemeal nature of existing work in the performance field have limited some aspects of operationalisation and analysis of the study. The limitations of this research provide fertile ground for many opportunities to extend the research in future by improving reliability and validity and eventually extending the focus, a challenging and exciting prospect.

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LIST OF APPENDICES

APPENDIX A

Interview Guide (as refined after initial testing)

UNIVERSITY OF BATH
SCHOOL OF MANAGEMENT

CRiSPS
Centre for Research in Strategic Purchasing and Supply

Case Study Interview Guide of Performance Measurement in Customer-Supplier Relationships

Interview / Case No:…………………………………………………………………..

Respondent: …………………………………………………………………..

Organisation: …………………………………………………………………..

Respondent Role: …………………………………………………………………..

Interviewer: …………………………………………………………………..

Date: …………………………………………………………………..

Interview respondents may request a copy of the aggregate research findings and analysis – a valuable aid to benchmark your own organisation.

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Part A: The Innovative Product

The first questions ask about your role, the organisation and an innovative product in which the organisation has been involved.

A1: Describe what your organisation does?

- Description of activities?
- Industrial sector / market?
- Turnover?
- No. Employees?

A2: Describe an innovative product that both your organisation and supplier or customer organisations have been involved in implementing. *(Zheng Zhou 2006, Tidd et al. 2005 pp88-97)*

A3: In what way is the product new? *(Tidd et al. 2005 pp5-13)*

- How is it new to the market?
- How is it new to the firm?

A4: How might your organisation benefit from the new product? *(Tidd et al. 2005 pp5-13)*

A5: To what extent does the new product have an impact on the NHS system? *(Harland et al. 2007)*

A6: To what extent does the product improve health? *(Harland et al. 2007)*

A7: What is the importance of purchasing the product for the NHS? *(Cost of product and consumables, value added profile)*. *(Kraljic 1983)*

A8: How complex is the supply market for the product? *(No. of suppliers, pace of technological advance, entry barriers, complexity)*. *(Kraljic 1983)*

A9: Can you also tell me about this and other product innovation projects in the past?

Part B: The Supply Relationship

The next questions ask about how the supply relationship has a role in performance measurement and performance management of the innovative product.

B1: Describe the customers and suppliers involved in producing this product.

- Draw a map of stakeholder actors. *(Oberg et al. 2007)*

B2: Describe what goes on in the relationships with customers / suppliers you mentioned earlier with whom you have been involved in implementing the innovative product.

- Is there interaction between the producer and the user of the innovative product? *(Thomke & Von Hippel 2002)*
- Are suppliers involved early in the development of the innovative product? *(Dowlatshahi 1998)*
- Are purchasing or supply involved in research partnerships as part of implementing the innovative product? *(Hagedoorn & Link 2000)*
- Is there sharing of profits and/or costs? *(Teece 1986)*
- Is the relationship collaborative? *(Swink 2006)*
    - Is there trust?
    - To what extent is there communication?
    - How are problems solved?
    - To what extent are there mutual objectives?

B3: How does the supply relationship have a role in performance measurement and performance management of the particular innovative product?

B4: Can you also tell me about supply relationships in the past?

Part C: Performance Measurement of the Innovative Product

The next questions ask about performance measurement of the product innovation project we discussed above.

C1: Do you measure the performance of this product? *(Neely et al. 2005, Farbey et al. 1993 pp75-94, Zheng Zhou 2006)*

C2: How do you measure the performance of this product?

- Who is involved with measuring performance?
- What are the activities needed to measure performance?
- What are the resources needed to measure performance?

C3: What kinds of performance measures of the innovative product are used?

- Financial measures? *(Hendricks & Singhal 2003)*
- Technical measures and operational measures? *(Kaplan & Norton 1992, Ittner and Larcker 1998a)*
- Quality of life measures? *(Skevington 1999)*
- Input, process, output or outcome measures? *(Slack et al. p10, Godwin et al. 1989)*

C4: What kinds of performance measurement systems are used?

- Balanced scorecards? *(Kaplan & Norton 1992)*
- Supplier/vendor assessment systems? *(Timmerman 1986, Lamming et al. 1996)*

C5: Who (organisations, individuals) carries out these performance measurement processes?

- The customer &/or supplier organisation?
- Which individuals in each organisation?

C6: What resources are necessary for these performance measurement activities?

C7: What performance measurement of innovative products happened in the past?

C8: Are there any other performance measurement processes we have not discussed?

Part D: Performance Management of the Innovative Product

Having asked about performance measurement, the next set of questions asks about performance management of the innovative product we mentioned above.

D1: What kinds of processes (activities, actors, resources) are used to manage performance? *(Radnor & McGuire 2004, Mintzberg & Lampel 1999, Halachmi 2005, Lebas 1995)*

- Who is involved with managing performance?
- What are the activities needed to manage performance?
- What are the resources needed to manage performance?

D2: Are the performance measurement processes we discussed earlier followed up by any performance management processes? *(Halachmi 2005, Lebas 1995)*

- Do you do anything with the performance measurement data once it is collected?
- Who sees the performance measurement data and how do they use it?
- Is performance measurement visible to anyone outside the organisation?
- Do your supplier or customer organisations do anything with the performance measurement data? (eg development, training)
- Are any rewards or penalties issued following performance measurement?

D3: What product innovation project performance management has occurred in the past?

D4: Are there any other performance management processes we have not discussed?

Part E: Innovative Product Performance

The next questions ask about performance itself of the innovative product we mentioned above.

E1: How do you describe the performance of the innovative product? *(Lebas 1995)*

E2: How does the innovative product perform?

E3: What would the innovative product look like if it was performing well or badly?

E4: How successful has the innovative product been for the customer / for you as a customer?
(Customer satisfaction, customer acceptance, market share goals, revenue goals, revenue growth goals, unit volume goals, no. of customers). (Griffin & Page 1996)

E5: Has the innovative product been a financial success?
(Met profit goals, met margin goals, IRR or ROI, break-even time). *(Griffin & Page 1996)*

E6: Has the innovative product been a technical success?
(Competitive advantage, met performance specs, speed to market, development cost, met quality specs, launch on time, innovativeness). (Griffin & Page 1996)

E7: How does measuring and managing the performance of the innovative product help or hinder the performance? *(Halachmi 2005, Bourne et al. 2005)*

	Customer-based Success (**E4**)	Financial Success (**E5**)	Technical Performance Success (**E6**)	Other Performance Effects Mentioned (**E7**)
Performance Measurement				
Performance Management				

E8: Can you tell me how innovative products in the past have performed, including whether this was helped or hindered by performance measurement and performance management?

Do you have any other comments on this topic?

APPENDIX B
Table of Interviews Carried out for the Case Studies

Table of Interviews Carried Out for the Case Studies

Respondent (Job Role)	Organisation	Type of Stakeholder Role	Length of Interview	Date	Location	Cases to Which Interview Relevant	Notes
Head of Medical Physics	Imaging Equipment Evaluation Centre	Customer. Influencer (national level)	0:50	12 Sep 06	Imaging Equipment Evaluation Centre	CT Scanner	
Head of Group	Imaging Equipment Evaluation Centre	Customer. Influencer (national level)	1:00	12 Sep 06	Imaging Equipment Evaluation Centre	CT Scanner	
Category Manager, Radiotherapy & Imaging	NHS PASA / Supply Chain	Customer. Buyer, Influencer (national level)	1:00	21 Nov 06	Telephone	CT Scanner	
Category Manager, Medical Maintenance	NHS PASA	Customer. Buyer, Influencer (national level)	0:20	20 Dec 06	Telephone	CT Scanner	
Consultant Radiologist, Clinical Lead Radiology	Hospital Trust	Customer. User, Buyer, Decider (local level)	0:35	14 Dec 06	Hospital Trust Site	CT Scanner	Head Group Eval Centre & E. Bakker also present
Consultant Gastrointestinal Radiologist	Hospital Trust	Customer. User, Buyer, Decider (local level)	0:35	14 Dec 06	Hospital Trust Site	CT Scanner	Head Group Eval Centre & E. Bakker also present
Consultant Cross-sectional and Radionuclide Radiologist	Hospital Trust	Customer. User, Buyer, Decider (local level)	0:50	15 Jan 07	Hospital Trust Site	CT Scanner	Head Group Eval Centre also present
CT Superintendent Radiographer	Hospital Trust	Customer. User, Buyer, Decider (local level)	0:55	14 Dec 06	Hospital Trust Site	CT Scanner	Head Group Eval Centre & E. Bakker also present
Radiology Business Manager	Hospital Trust	Customer. Buyer, Decider (local level)	1:15	15 Jan 07	Hospital Trust Site	CT Scanner	Head Group Eval Centre also present
Purchasing Manager	Hospital Trust 2	Customer. Buyer, Decider (local level)	1:35	10 May 07	Hospital Trust 2 Site	CT Scanner	
Account Executive, CT, X-Ray, MRI & Connectivity, Southern	CT Scanner Supplier	Supplier (regional level)	0:45	14 Dec 06	Hospital Trust Site	CT Scanner	Head Group Eval Centre & E. Bakker also present
Account Executive, South West	CT Scanner Supplier	Supplier (regional level)	1:00	17 Jan 07	BMI Clinic, Bath	CT Scanner	E. Bakker also present
Head & Biochemistry Director	Pathology Devices Evaluation Centre	Customer. Influencer (national level)	1:10	31 Aug 06	Pathology Devices Evaluation Centre	Blood Glucose Meter	Interviewed at same time as M. Batki

Technical Evaluation Leader	Pathology Devices Evaluation Centre	Customer. Influencer (national level)	1:10	31 Aug 06	Pathology Devices Evaluation Centre	Blood Glucose Meter	Interviewed at same time as G. Thorpe
Category Manager, Pathology	NHS Supply Chain	Customer. Buyer, Influencer (national level)	0:25	20 Dec 06	Telephone	Blood Glucose Meter	
Category Specialist, Pathology	NHS Supply Chain	Customer. Buyer, Influencer (national level)	1:10	30 Nov 06	Telephone	Blood Glucose Meter	
Pharmaceutical Services Manager	NHS Prescription Pricing Division	Customer. Decider, Gatekeeper (national level)	0:50	19 Jan 07	Telephone	Blood Glucose Meter	
Manager, Point of Care Testing Team	Hospital NHS Foundation Trust	Customer. Influencer, Buyer, Decider (local level)	0:50	22 Jan 07	Telephone	Blood Glucose Meter	
Diabetic Specialist Nurse	Hospital NHS Foundation Trust 2	Customer. User, Decider (local level)	0:35	7 Feb 07	Hospital NHS Foundation Trust 2 Site	Blood Glucose Meter	
Diabetic Specialist Nurse	Primary Care Trust	Customer. User, Decider (local level)	1:15	23 Feb 07	Telephone	Blood Glucose Meter	
Service Development Manager	Pharmacy Plc	Customer. Buyer, Decider (national level)	0:50	25 Jan 07	Telephone	Blood Glucose Meter	
Director Care and Policy	Diabetes UK	Patient Body. (national level)	1:00	17 Jan 07	Telephone	Standing Frame	Diabetic himself
Senior Marketing Manager	Blood Glucose Meter Supplier	Supplier (national level)	1:30	11 Jan 07	CRiSPS, Bath	Blood Glucose Meter	E. Bakker also present
Director General	British In-Vitro Diagnostics Association (BIVDA)	Supplier Industry Body (national level)	1:15	15 Jan 07	BIVDA, London	Blood Glucose Meter	
Director	General Medical Devices Evaluation Centre	Customer. Influencer, Decider (national level)	0:45	27 Sep 06	Telephone	ECG Monitor	
Category Manager, Cardiology	NHS Supply Chain	Customer. Buyer, Influencer (national level)	0:50	29 Jan 07	Telephone	ECG Monitor	
Category Specialist, Cardiology	NHS Supply Chain	Customer. Buyer, Influencer (national	1:00	12 Jan 07	Telephone	ECG Monitor	

		level)					
General Practitioner	GP Surgery	Customer. User, Buyer, Decider (local level)	0:20	26 Mar 07	GP Surgery	ECG Monitor	Trained as a cardiologist but has since worked as a GP
Practice Nurse	GP Surgery	Customer. User (local level)	0:25	26 Mar 07	GP Surgery	ECG Monitor	
CEO	ECG Monitor Supplier	Supplier (national level)	0:35	10 Jan 07	ECG Monitor Supplier	ECG Monitor	Interviewed at same time as P. Needham
Chief Technology Officer	ECG Monitor Supplier	Supplier (national level)	0:50	15 Mar 06	ECG Monitor Supplier	ECG Monitor	
Chief Technology Officer	ECG Monitor Supplier	Supplier (national level)	1:25	10 Jan 07	ECG Monitor Supplier	ECG Monitor	Nick Rawling joined for part of interview (0:10-0:45)
Research Director	Evaluation Centre, Assistive Technology	Customer. Influencer (national level)	1:35	26 Sep 06	Evaluation Centre, Assistive Technology	Standing Frame	Interviewed at same time as M. Clift
Centre Manager	Evaluation Centre, Assistive Technology	Customer. Influencer (national level)	1:35	26 Sep 06	Evaluation Centre, Assistive Technology	Standing Frame	Interviewed at same time as L. Pinnington
Centre Manager / Occupational Therapist	Evaluation Centre, Assistive Technology / University	Customer. Influencer (national level) / User, Buyer, Decider (local level)	0:40	3 Nov 06	Telephone	Standing Frame	
Lead Category Manager, Assistive Technology / Special Projects	NHS PASA / DH	Customer. Buyer, Influencer (national level)	1:00	01 Jan 07	Telephone	Standing Frame	
Category Specialist, Mobility & Telecare	NHS PASA	Customer. Buyer, Influencer (national level)	1:00	16 Jan 07	Telephone	Standing Frame	Also parent of child using standing products
Paediatric Physiotherapist	Hospital NHS Foundation Trust 2	Customer. User, Buyer, Decider (local level)	0:40	7 Feb 07	Hospital NHS Foundation Trust 2 Site	Standing Frame	
Paediatric Physiotherapist	Primary Care Trust 2	Customer. User, Buyer, Decider (local level)	1:35	16 Feb 07	Telephone	Standing Frame	
Physiotherapist	Primary Care Trust 3	Customer. User, Buyer, Decider (local level)	0:40	20 Feb 07	Telephone	Standing Frame	
Managing Director	Standing Frame Supplier	Supplier (national level)	1:30	15 Nov 06	Standing Frame Supplier	Standing Frame	

					Site		
Director General	British Health Trades Association	Supplier Industry Body (national level)	1:05	5 Feb 07	Telephone	Standing Frame	Interviewed at same time as P. Charlton-Smith
Chairman of Seating & Positioning Division	British Health Trades Association	Supplier Industry Body (national level)	1:05	5 Feb 07	Telephone	Standing Frame	Interviewed at same time as R. Hodgkinson
Policy and Innovation Director	NHS PASA	Customer. Influencer (national level)	1:25	26 Jan 07	NHS PASA, Reading	All	
Senior Collaborative Development Manager	NHS PASA	Customer. Influencer (national level)	0:40	21 Nov 06	CRiSPS, Bath	All	
Head of R&D	NHS PASA	Customer. Influencer (national level)	1:20	1 Dec 06	CRiSPS, Bath	All	
Senior Manager for Technology Introduction	NHS Institute for Innovation and Institute	Customer. Influencer (national level)	0:55	6 Feb 07	Telephone	All	

APPENDIX C
List of Codes Used in HyperResearch

List of Codes Used in HyperResearch

Code Name (& Group)	Code Description from HyperResearch	Type of Code (Miles & Huberman 1984 p56)	Research Questions Code is Relevant to
PMeas – Expert actors required	Marks passages where respondent mentions that actors with expertise in a particular area are involved in performance measurement processes. Code developed during initial coding. Refers to the actors involved in performance measurement processes (actors, activities & resources).	Descriptive	A,C
PMeas – Measuring customer perf	Marks passages where the respondent describes processes of measuring customer performance (Griffin & Page 1996) of the product. The customer performance measures used may also be described as part of this. Quality of life measures are also included as part of customer performance measures (Skevington 1999). This code also includes customer actors using the product if they have already bought one, where they measure performance through use, the information from which may be used in a rebuy situation.	Descriptive	A,C
PMeas – Measuring financial perf	Marks passages where the respondent describes processes of measuring financial performance (Griffin & Page 1996) of, or in relation to the product. The financial performance measures used may also be described as part of this. (Hendricks & Singhal 2003)	Descriptive	A,C
PMeas – Measuring technical perf	Marks passages where the respondent describes processes of measuring customer performance (Griffin & Page 1996) of the product. The technical performance measures used may also be described as part of this. Examples include traditional technical evaluation in the CEP Evaluation Centres (Menes et al. 2006) and measuring technical performance of the product during initial development (Tidd et al. 2005 pp561-569).	Descriptive	A,C
PMeas – Resources required	Marks passages where respondent mentions that resources such as time, money and physical resources are required for performance measurement processes. Code developed during initial coding. Refers to the resources involved in performance measurement processes (actors, activities & resources).	Descriptive	A,C
PMgmt - Advice or policy guidance	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving issuing advice to actors (Hume & Wright 2006) This code also includes issuing policy guidelines, such as on a national level.	Descriptive	A,C
PMgmt – Checking perf against expected	Marks passages where the respondent mentions a broader or follow up process to performance measurement, involving checking the results of performance measurement against expected performance (Globerson 1985). The code includes processes such as benchmarking, quality control and post sales monitoring of performance.	Descriptive	A,C
PMgmt - Feedback	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving feedback between actors in the case (Globerson 1985).	Descriptive	A,C

PMgmt – Improving product design	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving making improvements to the product design, which are featured in all subsequent products produced or served. An example is re-innovation of the product (Rothwell & Gardiner 1988, Tidd et al. 2005 p96).	Descriptive	A,C
PMgmt – Involving senior organisations	Marks passages where respondents mention a broader, or follow up, process to performance measurement of involving more senior level organisations or bodies. Code developed during initial coding.	Descriptive	A,C
PMgmt – Product training	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving training of actors in product use (Lebas 1995).	Descriptive	A,C
PMgmt – Publications	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving producing or disseminating publications based upon performance measurement. This code was developed during initial coding.	Descriptive	A,C
PMgmt – Purchasing or marketing decision-making	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving the decision-making process in purchasing a product (Webster & Wind 1972 pp28-39, 89-98, Biemans 1992 pp129-140). This code also includes processes from the supplier side that may be involved in the purchasing decision-making process, such as use of performance measurement information in marketing materials.	Descriptive	A,C
PMgmt - Tailor to customer	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving tailoring the product to the needs of a particular customer in a particular product exchange (Stump *et al.* 2002).	Descriptive	A,C
PMgmt – Web tools	Marks passages where respondents mention a broader, or follow up, process to performance measurement involving producing or disseminating information based upon performance measurement in a format of web based tools or applications, for example a database of products. This code was developed during initial coding.	Descriptive	A,C
PMeas or PMgmt assists rules compliance	Marks passages where respondents mention that performance measurement or performance management processes have assisted in complying with rules, regulations or legislation. This code was developed during initial coding.	A descriptive or interpretive code	B,C
PMeas or PMgmt buyers use in purchasing	Marks passages where respondents mention that performance measurement or performance management processes are used, or need to be used by actors such as buyers in making a purchasing decision (Webster & Wind 1972 pp28-39, 89-98, Biemans 1992 pp129-140).	A descriptive or interpretive code	B,C
PMeas or PMgmt dysfunctional consequences	Marks passages where respondents mention that performance measurement or performance management processes have dysfunctional consequences for performance (Ridgway 1956).	A descriptive or interpretive code	B,C
PMeas or PMgmt no role in customer perf	Marks passages where respondents mention that performance measurement or performance management processes do not have an influence on customer performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C

PMeas or PMgmt no role in financial perf	Marks passages where respondents mention that performance measurement or performance management processes do not have an influence on financial performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt no role in perf	Marks passages where respondents mention that performance measurement or performance management processes do not have an influence on performance itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt no role in technical perf	Marks passages where respondents mention that performance measurement or performance management processes do not have an influence on technical performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt re-designed product improved	Marks passages where respondents mention that performance measurement or performance management processes have improved the technical design of the product (Rothwell & Gardiner 1988, Tidd et al. 2005 pp96). The code is also used where general product faults during the life of the product are rectified.	A descriptive or interpretive code	B,C
PMeas or PMgmt role in customer perf	Marks passages where respondents mention an influence of performance measurement or performance management processes in customer performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt role in financial perf	Marks passages where respondents mention an influence of performance measurement or performance management processes in financial performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt role in perf	Marks passages where respondents mention an influence of performance measurement or performance management processes on performance itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt role in technical perf	Marks passages where respondents mention an influence of performance measurement or performance management processes on technical performance (Griffin & Page 1996) itself. This code was developed form the conceptual framework, in turn based upon the literature review.	An explanatory or pattern code	B,C
PMeas or PMgmt supplier competitive about	Marks passages where respondents mention that suppliers are competitive about performance measurement or performance management processes or their outputs, suggesting they believe it has an influence on performance. Code developed during initial coding.	A descriptive or interpretive code	B,C
PMeas or PMgmt tailored product appropriate customer	Marks passages where respondents mention that performance measurement or performance management processes have tailored the product making it more appropriate for the customer (Athaide & Stump 1999).	A descriptive or interpretive code	B,C
Context – complex supply market	Marks passages where respondents mention that the supply market for the product is complex (Kraljic 1983).	Descriptive	B,C

Context – low complexity supply market	Marks passages where respondents mention that the supply market for the product is not complex, or has low complexity (Kraljic 1983).	Descriptive	B,C
Context – rel collaboration	Marks passages where respondents mention that the supply relationship is collaborative (Swink 2006, Hagedoorn & Link 2000). It may be long term, be described as a partnership or at a high or strategic level of development, and may feature mutual objectives and trust.	Descriptive	A,C
Context – rel communication	Marks passages where respondents mention that communication, or information exchange (IMP Group 1982) occurs in the supply relationship. Initial coding highlighted that communication is a performance measurement process.	Descriptive	A,C
Context – rel different perf claims	Marks passages where the respondent mentions that some actors in the case made different performance claims to others. This code was developed during initial coding.	Descriptive	B,C
Context – rel role in perf	Marks passages where respondents mention that the supply relationship has an influence on performance (Ritter & Gemunden 2004, Chapman & Corso 2005, Grandori & Soda 1995).	An explanatory or pattern code	B,C
Context – rel social exchange	Marks passages where respondents mention that a process of social exchange (IMP Group 1982), such as visits between customer and supplier actors occurs in the supply relationship. Initial coding highlighted that social exchange is a performance measurement process.	Descriptive	A,C

NB Abbreviations: ‘Perf’ is Performance, ‘PMeas’ is Performance Measurement, ‘PMgmt’ is Performance Management, ‘Rel’ is Relationship as in the supply relationship.

APPENDIX D
Worksheet Showing Results of Testing Findings for Construct Validity by a Fellow Researcher

Data Provenance Test

This sheet records the process of testing the data by an academic other than the author. Testing involves taking a finding as reported in the data tables contained within the thesis chapters, then tracing the provenance of the finding back through analysis tables and to the original data.

Academic Name: Dr Thomas Johnson

Date: 30/4/2007

% of reported findings traceable through analysis process: 100

Finding in Data Tables from Thesis Chapters *(Intra-case, inter-case and effects matrices)*	**Traced?**
CT case, radiology manager	yes
BGM case, PaSA interview	yes
SF case, CEO interview	yes
ECG case, Policy & Innovation Director (PaSA)	yes
ECG, CEO-supplier	yes
CT case, radiology	yes
BGM, Head of eval. centre	yes
CT case - inter-case table	yes
SF - inter-case table (performance measure)	yes
Role effects matrix, BGM	yes

APPENDIX E
Comments from External Validation of Case Descriptions

From: "Forrest, Samantha" <Samantha.Forrest@pasa.nhs.uk>
To: Graham Dickinson <mnmgtd@bath.ac.uk>
Subject: Your chapter
Date-Sent: 29 April 2008 16:20 +0100

Graham

Sincere apologies for taking so long to respond but I've been overtaken with other things since reading through your chapter. Here are a few comments which I hope will suffice..

Structure
The structure for presenting the findings is clear and helpful, with the case description setting out the supply network and relationships as a context for the discussions about performance management and measurement. Sections are well 'sign-posted' throughout so that the reader knows what to expect.

General
The chapter draws a clear and consistent distinction between performance management processes and performance measurement processes and successfully illustrates how these inform and influence (or otherwise) the purchasing decision in each case and at different levels.

At the time the research was conducted, key changes were being enacted in respondents' organisations, notably the transfer of national purchasing to NHS Supply Chain and the change programme at CEP. The former is mentioned in one or two of the individual cases but perhaps not clarified sufficiently; the latter is not really alluded to. I think this is relevant because some of the issues that respondents had with the evaluations related to old-style DES evaluations and would be addressed to some extent in the reformed organisation and new-style outputs. I was planning to comment on this as it relates to individual cases but time is against me, I'm afraid. However, a couple of comments below relate to the scanner case as an example.

CT scanner case
P7 - CEP is part of PASA (therefore DH/central govt) not part of the NHS

P7 - The description of the evaluation process gives the impression that this is a regular or ongoing process. Usually, evaluations are requested by a stakeholder in response to a particular need or change eg new products/innovations on the market, related to a forthcoming tender exercise etc and will be one-off projects unless or until another evaluation is requested and approved.

If I get time before the end of the week, I'll develop this a bit more, but I hope this gives you something to work with.

Kind regards
Sam

APPENDIX F
Matrix of Findings from Respondents in the CT Scanner Case

Respondent / Research Question (RQ) Theme	**Performance Measurement** (RQs:A,C)	**Performance Management** (RQs:A,C)	**Performance Measurement/Performance Management Influence on Performance** (RQs:B,C)
Head Medical Physics, Evaluation Centre	Technical evaluation of technical parameters is carried out by Evaluation Centre, attended by supplier representatives.	Evaluation reports and data are published and put on the internet.	Suppliers show concern that evaluation results affect purchasing of the scanner
Head Group, Evaluation Centre	Technical evaluation of technical parameters is carried out by Evaluation Centre, data is shared between the Centre and supplier during and after the evaluation.	Evaluation reports & tools for scanner users are produced, also in a web based form.	Trusts use technical evaluation outputs when purchasing a scanner, suppliers show concern over the results of the evaluations.
Category Manager Imaging, NHS PASA/Supply Chain	Upfront cost, revenue costs & utilisation are all measured. Trust clinicians make site visits to assess performance of the scanner, information is exchanged with supplier	Purchasing decisions about the scanner are made, supplier tailors scanner package to Trust needs, feedback on measurement is given to supplier, the scanner design has been improved	Hardware & service improved. Information from performance measurement is used in making purchasing decisions, scrutinising pricing and technical performance.
Category Manager, Maintenance, NHS PASA	Cost of maintenance is measured. Service surveys are carried out, focussing on scanner uptime.	Feedback of performance information to supplier, supplier makes improvements to service package.	Service configuration has been improved. Measures can be unreliable in describing performance.
Radiologist (Lead), Hospital Trust	Determining if scanner package meets clinical specialisms, packages are compared against set budget, experts are consulted. Clinicians make site visits, trial use of the scanner. Post-tender discussion occurs with suppliers.	Purchasing tender process, purchasing team discuss scanner packages on offer, compromise over their various interests in deciding which scanner to purchase.	Clinical benefits are gained from the particular scanner package purchased through the tender process. Feedback has been given to the supplier, but has not been used to change the scanner design as Trust is a small customer.
Gastrointestinal Radiologist, Hospital Trust	Assesses the ease of interpreting scanner images for specialist clinical work. Site visits are made to look at scanners and talk to users.	Clinicians in the Trust go through a decision-making process about which scanner to purchase.	Processes have no influence as not enough time to gather information needed to make a purchasing decision. Would not decide on the basis of supplier demos.
Cross-sectional & Radionucleide Radiologist, Hospital Trust	Scanners are compared against a set budget, assesses if scanner meets clinical specialisms, technical criteria are measured. Site visits are made to assess scanner performance, calls are made to colleagues in other Trusts.	A purchasing tender process involves decision-making, bids from scanner suppliers are scored, though flexible use is made of the scoring system. The supplier and competitors are given feedback following the outcome of the tender process.	The purchasing tender process means the best scanner for needs of the Trust is bought, however cost impacts whether the scanner or a competing product is chosen.
Superintendent Radiographer, Hospital Trust	Looks at scanner dose, ease of training radiographers to use it and ease of use for Trust's needs. Site visits are made to trial use of the scanner, tell the supplier what is needed in the package.	Decisions are made to purchase the scanner or a competing scanner through discussion of bids against the tender specification. Supplier staff train users in operation of the scanner. Feedback about scanner performance is given to the supplier.	An improved scanner over the existing one is bought for the Trust following assessment of scanner performance and the tender process. The influence of feedback is unclear as good scanner features can be maintained, however other suggested improvements have not been made.
Radiology Business Manager, Hospital Trust	Technical parameters of the scanner are assessed, ease of use in Trust specialisms and uptime. Site visits are made, actors talk to colleagues, long-term maintenance cost is assessed as servicing involved.	A purchasing decision is made, the performance of the scanner and competing products is checked against the specification, feedback is requested by and given to the supplier.	Assessing performance and the tender process helps purchase the best scanner for Trust. Performance measurement information is used in acceptance testing and to get repairs made.
Purchasing Manager, Hospital Trust 2	Lifetime costs are assessed of purchasing v leasing the scanner. User and technical assessments are made. Clinicians make site visits for scoring scanner.	A purchasing tender process includes scoring & ranking of scanner attributes to make purchasing decision. CEP reports are produced following technical evaluations.	Information gathered in the tender process and scoring are used to decide which scanner is purchased. CEP reports are too late, purchasers knowledgeable anyway. *Continued overleaf*

Account Executive SE, Supplier	Technical parameters are measured in design specifications, purchasers include technical & financial measures in tender specification, user opinions about the scanner are gathered by the supplier. Supplier visits Trust, demonstrates the scanner.	Purchasing decisions are made by Trusts, feedback occurs from test sites, users and evaluation centre, improved scanner software has been developed by the supplier.	Purchases are made and the scanner sold or not on the basis of information from performance measurement. Scanner software & radiation dose have been improved following feedback. Evaluation centre evaluation outputs are late, not novel and have no influence.
Account Executive SW, Supplier	Budget, functionality for particular needs of Trust are assessed. Two way site visits occur to understand Trust needs, trial use. Study days are arranged for users.	Purchasers decide between the scanner and competing scanners. Every scanner package tendered is tailored to the Trust. Training of users. Re-design of the scanner.	Processes have a limited influence as each purchasing decision is made on a different basis, the supplier cannot always influence the outcome.
Policy & Innovation Director, NHS PASA	Savings & line price models to measure financial performance of products. Broader value, of innovations sometimes measured.	Purchasing decision-making. Evaluation Centre publication outputs to evaluations.	Processes do not currently have an influence as more proactive evidence of value needed, integrated into NHS.
Senior Collaborative Development Manager, NHS PASA	Clinical experts are consulted for their views. Stakeholder communication has been a key way of gathering information in setting up CPHs.	Decision-making about products to purchase by purchasers in the NHS.	Processes have limited influences as purchasing decisions are often made for other, short term reasons.
Head R&D, NHS PASA	Measurement of savings and budgets are key, supplier KPIs and policy targets are used. Category staff specialists keep up with market, communicating with suppliers.	Decision-making about products to purchase by purchasers in the NHS. National level advice provided to local level purchasers by PASA staff.	Products are purchased without advice and information from performance measurement. Although evidence of technical performance may exist, budget holder still has to be convinced to pay if product is to be purchased.
Senior Manager for Technology Introduction, NHS III	Assessment is made of the technical nature of product including patents, business plan of the supplier to exploit it.	III staff make the decision of whether to back a product financially.	Information gathered on a product and decision results in it being backed financially or not. Checking performance against regulations encourages the supplier to ensure product meets claims.

Summary Matrix of Key Findings Discovered in Coding in Multi-Slice CT Scanner Case (Cut 1: by respondent, cut 2: by theme in conceptual framework)

Method to Produce the Summary Table:

The table is a display format summarising the large amount of data from the original intra-case table that was produced from the respondent interviews coded using HyperResearch. The table is an un-ordered meta-matrix showing all the respondents in the case. The matrix is ordered by role in the rows and conceptual framework theme in the columns, the latter determined by the research questions, as recommended by Miles & Huberman (1984 pp79-80).

The cells in the matrix show *"…short quote and summarising remarks…"* (Miles & Huberman 1984 p80) qualitatively describing the data coded in relation to the research questions in the original table. Code frequencies within the case are shown in a separate table. The qualitative remarks are produced following data reduction and weighting as suggested by Miles & Huberman. The latter was according to a decision rule where only findings relating to general codes that are matched by more than one respondent within the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Miles and Huberman (1984 pp104) advocated the following example, using the same method as in entering the data in the matrix here: *"…the data being entered in each cell are a brief summary of what the analyst found for each respondent in the field notes. The main decision rule appears to be this: if it's in the notes, summarise it and enter a phrase reflecting the summary."* Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response.

The research questions look at performance measurement and performance management processes. Performance measurement processes are also represented in the table by mention of the measures used, firstly for brevity, secondly because measurement procedures have been described as mapping and preserving the difference in a set of symbols and a collection of entities (Farbey *et al.* 1993 pp75-94), and finally because many respondents answered the questions about performance measurement processes by listing the measures that are used.

APPENDIX G
Code Occurrences by Respondents in the CT Scanner Case

CODE	Head Med Phys	Head Group, Eval Centre	Cat Mangr Imaging	Cat Mangr, Maint	Radiol (Lead)	Radiol, Gastro	Radiol, X sect	Radiog	Radiol Business Mangr	Purch Manager, Trust	Acct Exec SE. Supplr	Acct Exec SW. Supplr	Policy & Innov Director, PASA	Collab Devpt Mangr, PASA	Head R&D PASA	NHS III Mangr
Expt actors	1	2			3	2		1	1					2		1
Meas cust perf	1		2	3	7	3	9	8	7		9	9	1	6	4	2
Meas finc perf			5	1	2		5		8	4	2	5	3		1	2
Meas tech perf	13	23	9	2	7	1	5	11	16	5	8	3	6	1	3	5
Resorc	2	3							1							
Advice policy guid		3	2						1				1		1	
Check expctd	1	7	3		4		1	3	5		3	1		1		1
Feedbck	1	4	3	1	3		2	3	3		10	2				
Imp prdct design		1	3	1	1				2		3	1				
Senior org	1		1												1	
Prdct traing								1		1	4					
Publctn	2	15	1						1	4			3		1	
Purch mktg dec	5	10	7		9	2	8		9	13	7	3	2	4	3	3
Tailor cust		1	2		3		1	1	2		1	2				
Web tools	1	6	1													

Assist rule compl		1							1							
Buyers use	4	7	2		5		5	3	8	10	7	1	1	1	2	2
Dysfunc conseq				1	1		1	1		3	1	1				1
No role cust perf	1											1				
No role finc perf	1											1				
No role perf	2				1	2	2	2	1	5	4	3	7	2	1	1
No role tech perf					1		1				3			2		
Re-des prdct impvd		1	3						1		3					
Role cust perf		3	1		5		4	3	1	1	6				1	
Role finc perf	4	2	3		1				6	2	4	2				2
Role perf	9	17	10	1	7		6	3	11	8	9	2	1	1	3	3
Role tech perf	3	7	5		2		1		6	5	2	1	1		1	1
Supplrs competv	5	4	1		1				1							
Tailord appropt		1							1							
Cplx Mkt																
Low cplx mkt																
Collab			1						1		1		1			1
Comm	2	3	1		1		5	2	1	1	4	1		2	1	1

Diff claims				1												
Rel role perf			1						2		2					
Soc xchange	3	2	2		1	1	4	2	2	1	6	5		1		

<u>Code Occurrences by Respondent in Multi-Slice CT Scanner Case</u>

Data compiled from HyperResearch Report Function.

APPENDIX H
Notes and Key to the Network Pictures

Notes and Key to the Network Pictures

Definitions

Flows in the diagram are categorised according to the major flows described by interviewees. They include the following:

- Product: A product, normally the medical device, passes from one actor in the network to another.
- Finance: A flow of money from one actor in the network to another.
- Commissioning: Refers to the activities of delivering healthcare in the NHS at a local level. The term is also used in particular cases in practice, such as the setting up of a new CT Scanner, though the definition used here is that of the NHS for consistency.
- Assignment: The term is used to describe situations where one network actor assigns, requests or tasks another actor to an activity. For example CEP assigns evaluation centres to carry out evaluations.
- Information: Many of the flows between actors are of information.
- Care: Care flows describe the actual physical delivery of care to the patient, for example by clinicians.

Abbreviations

ISTC-Independent Sector Treatment Centre, CEP-Centre for Evidence Based Purchasing, DoH-Department of Health, SHA-Strategic Health Authority, PASA/CD-Purchasing & Supply Agency/Commercial Directorate, OGC-Office of Government Commerce, NIC – National Innovation Centre, GP-General Practitioner, PPD(NHSBSA)-Prescription Pricing Division (NHS Business Services Authority), DES-Department for Education & Skills, BHTA-British Healthcare Trades Association, NAEP – National Association of Equipment Providers

Notes

Circled items on the network map represent stakeholders or actors. Flows between actors represent activities. Committees involving multiple actors or initiatives are often described as stakeholders by respondents, but must be included as activities so are represented by arrows.

The size of circles around actors is not significant

Public sector actors are shown in plain type, private sector organisations in italics

Interviewees or their organisations are indicated by yellow highlighting.

APPENDIX I

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Multi-Slice CT Scanner Case

Influence	Respondents who Described Influence	Performance Measurement Predecessors	Performance Management Predecessors	Researcher Explanation
Product is purchased or not +/- F/C	Head Med Phys, Head Group, Cat Mangr Imaging, Radiol (Lead), Radiol, X sect, Radiog, Radiol Business Mangr, Purch Manager, Acct Exec SE., Acct Exec SW., Policy & Innov Director, Collab Devpt Mangr, Head R&D, NHS III Mangr	Clinicians in the Trust purchasing team assess scanner performance for their particular needs & interests. Communication and visits between customer and supplier. Technical evaluation by Evaluation Centre. Assessment of purchase and maintenance costs.	Use of performance measurement information such as clinician's assessments, evaluation centre outputs. Making the purchasing decision. Marketing the scanner to the customer. Purchasing tender process with scoring and weighting, checking tenders against specification, committee discussion, compromise.	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare.
The best product for the needs of the user is purchased + C	Radiol (Lead), Radiol, X sect, Radiol Business Mangr	Assessing the customer performance of the CT scanner.	Making purchasing decision, tender process in Trust.	The tender process of assessing performance of the various scanners available and decision-making gives the Trust the best CT scanner for their particular needs.
Product can be purchased or not for short-term, cost based rather than broader reasons - C	Radiol, X sect, Policy & Innov Director, Radiol, X sect, Purch Manager, Acct Exec SE., Collab Devpt Mangr, Head R&D	Assessing cost of scanner.	Purchasing decision-making processes by Trust buyers.	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.

Information not used in the purchasing decision None	Head Med Phys, Radiol (Lead), Purch Manager, Acct Exec SW., Collab Devpt Mangr, Head R&D	Technical evaluation by Evaluation Centre, supplier product information, demonstrations and visits.	Technical evaluation outputs.	Information from performance measurement and management processes is not used in the purchasing decision. The product may be bought for all sorts of reasons other than on the basis of performance measurement information. Technical evaluation reports are too late, clinicians know already or do not have time to use info.
Product design improved + T	Cat Mangr, Maint, Acct Exec SE.	Customer surveys, technical assessment.	Feedback to supplier, supplier makes design changes, free upgrades given by supplier to reference site.	The design of the CT scanner and associated package is permanently improved, for example through new software releases, an improved service package.
Feedback to the supplier is not used None	Radiol (Lead), Radiog	Assessing customer performance.	Feedback to supplier.	Feedback on performance measurement information given to the supplier is not used. Customer is small.
Used in acceptance testing + T	Head Group, Radiol Business Mangr	Technical evaluation by Evaluation Centre.	Checking performance of the scanner against what was promised in the supplier's tender returns.	Performance measurement outputs such as technical evaluation reports are used to ensure a scanner meets the promised specification on installation, before full payment is made to the supplier.
Useful for repairs + T	Head Group, Radiol Business Mangr	Technical evaluation by Evaluation Centre.	Checking of scanner performance against expected.	Customer's own performance data makes the case to the supplier to come and make repairs to the scanner.

Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not + T	Cat Mangr Imaging, NHS III Mangr	Technical evaluation by Evaluation Centre.	Checking performance of product against claims. Feedback to supplier. Making purchasing decision.	Performance measurement and management processes mean that the supplier know and ensure that the product must meet a certain standard.
Supplier shows concern over performance measurement ***** +/- F	Head Med Phys, Head Group, Radiol Business Mangr	Technical evaluation by Evaluation Centre.	Technical evaluation outputs, information given to suppliers as part of tender process.	Suppliers show concern that performance measurement data will affect their competitive position or sales.

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Multi-Slice CT Scanner Case.

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).
Constructing the matrix: Cell entries are brief phrases highlighting inflluences coded in the case study and shown in the original large matrix of findings from respondents in the case. Processes with the influences, or implicit predecessors are shown. Intended outcomes or those that will occur are also shown (Miles & Huberman 1984 pp114-118). Only those influences that were seen in a pattern across more than one respondent in the code occurrences by respondent in the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response, guided by those in the summary matrices of findings for each case.

APPENDIX J

Matrix of Findings from Respondents in the Blood Glucose Meter Case

Respondent / Research Question (RQ) Theme	**Performance Measurement** (RQs:A,C)	**Performance Management** (RQs:A,C)	**Performance Measurement/Performance Management Influence on Performance** (RQs:B,C)
Head & Biochem Director, Evaluation Centre	Technical evaluation of technical parameters, liaison between Evaluation Centre and supplier over results. High cost and resource demand of evaluation.	Evaluation reports produced. Purchasing. Referral to MHRA if a problem found with the product.	Purchasers use reports to decide which meter to purchase. A bad evaluation report affects sales. Patient must act on meter result otherwise meter does not perform for them by managing their disease.
Technical Evaluation Leader, Evaluation Centre	Technical evaluation of technical parameters, experts are involved, supplier checks evaluation data.	Purchasers use technical evaluation outputs when making purchasing decisions.	Supplier willing to be evaluated suggesting the evaluation has an influence on product performance. Positive feedback on reports received from purchasers.
Category Manager Pathology, NHS Supply Chain	Clinical specification, cost implications, service delivery by supplier are measured. Ongoing communication with Evaluation Centre and supplier at local level unless a problem occurs.	Purchasers use performance measurement information in making decisions about which meter to buy, checking meter meets description. Referral to MHRA or NHS Supply Chain if problem with meter.	Meters purchased or not following purchasing decision. Suppliers know meter must perform if it will be measured. Training is necessary if users are to operate meter correctly and it is to perform for them.
Category Specialist Pathology, NHS Supply Chain	Technical specification of the meter and strip price are assessed. Regular meetings between NHS Supply Chain and supplier, data gathered locally for problem solving.	Advice and guides given to purchasers. Purchasing decision-making.	Meter bought or not. Little management of meters or disease after purchase and patient testing. Little use has been made of technical evaluation reports.
Pharmaceutical Services Manager, NHS PPD	Strip price and % reduction, meter service package measured. CE mark checked as technical assessment. Supplier provides all evidence to PPD to evaluate.	Performance checked against existing strips. Decision made by committee using performance information to list strip on NHS drug tariff or not.	Blood glucose meter strip available on prescription. 12% price cut achieved by PPD. Listing process does not aid listing innovative strips, only similar to existing.
Manager Point of Care Testing Team, Hospital NHS Foundation Trust	Ease of use and making mistakes by clinicians trialling meter. QA data gathered. Evaluation data shared with supplier.	Purchasers make decisions on basis of performance measurement information. Checking meter results are as expected. Training users.	Meters bought or not following purchasing decisions and performance measurement. Measurement identifies problems to solve and meters to avoid using.
DSN, Hospital NHS Foundation Trust 2	Accuracy, simplicity, are assessed in a subjective evaluation for particular patient. Supplier visits.	Choosing a meter with patient. User feedback to supplier reps. Performance measurement publications.	Patient given preferred meter. Design of the meter improved following feedback and recall.
DSN, PCT	Assessment of suitability of the meter for a particular patient. Increasingly measuring cost of strips and monitoring. Communication with supplier via feedback line and visits.	Feedback is given to and gathered by the supplier from users. User training by DSNs and the supplier. Decision making occurs about which meter is best for a particular patient.	Currently there is little evidence on benefits for patient of testing with a meter and little action is taken on test results, with no influence on performance. Sales are made following the measurement and management processes.
Service Development Manager, Pharmacy	Measurement of margin on meter sales and ease of use. Evaluation Centre conduct technical evaluation. Supplier gives product information to pharmacy, pharmacy give information to patients.	Pharmacy committee and clinicians make purchasing decisions. Reports and a formulary have been produced using information from performance measurement.	The scales on the meter and ease of use have been improved following performance measurement. The meter is purchased following processes. Evaluation Centre reports were used in decision making.
Director Care & Policy, Diabetes UK	Current research is measuring effectiveness of testing with meter. QA and quality of life measurement. Evaluation Centre technical evaluation.	Helplines, publications and advice are offered by Diabetes UK. Checking meter performs as expected by comparing information from performance measurement.	Little clinical guidance on testing with meter, action on meter results. Little report use. CE mark on the meter cannot be relied upon as a performance indicator.
Senior Marketing Manager, Supplier	Sales, market share, profit are measured. User forums & surveys, clinical trials are used. Communication between supplier and users occurs day to day in field.	Education programmes are provided. Feedback from users about product performance is gathered. Product re-design has occurred.	Training package has helped empower patients to manage their disease, not just monitor it. New display/scale has been introduced, meters replaced free.
Director General, BIVDA	Strip price and % cut are measured, technical evaluations occur, service package is assessed. Communication for information about product occurs with suppliers, NHS on national level, Diabetes UK.	Negotiations occurred over % cut in strip price. Decision making about purchasing the meter. Reports are produced using information from performance measurement.	A 12% cut strip price has occurred. Suppliers use information about meter performance to compete with rivals. Performance measurement has an influence on gaining regulatory approval for meter.

Continued overleaf

Policy & Innovation Director, NHS PASA	Savings & line price models to measure financial performance of products. Broader value, of innovations sometimes measured.	Purchasing decision-making. Evaluation Centre publication outputs to evaluations.	Processes do not currently have an influence as more proactive evidence of value needed, integrated into NHS.
Senior Collaborative Development Manager, NHS PASA	Clinical experts are consulted for their views. Stakeholder communication has been a key way of gathering information in setting up CPHs.	Decision-making about products to purchase by purchasers in the NHS.	Processes have limited influences as purchasing decisions are often made for other, short term reasons.
Head R&D, NHS PASA	Savings and budgets key, supplier KPIs. Category staff specialists keep up with market & suppliers	Decision-making about products to purchase by purchasers in the NHS. National level advice provided to local level purchasers by PASA staff.	Products are purchased without advice and information from performance measurement. Although evidence of technical performance may exist, budget holder still has to be convinced to pay if product is to be purchased.
Senior Manager for Technology Introduction, NHS III	Assessment is made of the technical nature of product including patents, business plan of the supplier to exploit it.	III staff make the decision of whether to back a product financially.	Information gathered on a product and decision results in it being backed financially or not. Checking performance against regulations encourages the supplier to ensure product meets claims.

<u>Summary Matrix of Key Findings Discovered in Coding in Blood Glucose Meter Case</u> (Cut 1: by respondent, cut 2: by theme in conceptual framework)

Method to Produce the Summary Table:

The table is a display format summarising the large amount of data from the original intra-case table that was produced from the respondent interviews coded using HyperResearch. The table is an un-ordered meta-matrix showing all the respondents in the case. The matrix is ordered by role in the rows and conceptual framework theme in the columns, the latter determined by the research questions, as recommended by Miles & Huberman (1984 pp79-80).

The cells in the matrix show *"…short quote and summarising remarks…"* (Miles & Huberman 1984 p80) qualitatively describing the data coded in relation to the research questions in the original table. Code frequencies within the case are shown in a separate table. The qualitative remarks are produced following data reduction and weighting as suggested by Miles & Huberman. The latter was according to a decision rule where only findings relating to general codes that are matched by more than one respondent within the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Miles and Huberman (1984 pp104) advocated the following example, using the same method as in entering the data in the matrix here: *"…the data being entered in each cell are a brief summary of what the analyst found for each respondent in the field notes. The main decision rule appears to be this: if it's in the notes, summarise it and enter a phrase reflecting the summary."* Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response.

The research questions look at performance measurement and performance management processes. Performance measurement processes are also represented in the table by mention of the measures used, firstly for brevity, secondly because measurement procedures have been described as mapping and preserving the difference in a set of symbols and a collection of entities (Farbey *et al.* 1993 pp75-94), and finally because many respondents answered the questions about performance measurement processes by listing the measures that are used.

APPENDIX K
Code Occurrences by Respondents in the Blood Glucose Meter Case

CODE	Head, Eval Centre	Tech Eval Leader, Eval Centre	Cat Mangr Path	Cat Spec, Path	Pharm Serv Mangr, PPD	Mangr, Pt Care Test Team	DSN, Found Trust	DSN, PCT	Serv Devpt Mangr, Pharcy	Direct Care & Policy, Diabetes UK	Senr Mktg Mangr, Supplr	Direct Generl, In-vitro Diag Assoc	Policy & Innov Director, PASA	Collab Devpt Mangr, PASA	Head R&D PASA	NHS III Mangr
Expt actors		1				1					1			2		1
Meas cust perf				2	2	10	8	7	2	3	7	2	1		3	2
Meas finc perf			2	2	8	2		3	3	1	2	6	3		1	2
Meas tech perf	12	2	5	3	5	10	3	5	9	7	6	7	6	1	2	5
Resorc	2						1		1		1					
Advice policy guid			1	6				1	2	3	1		1		1	
Check expctd			3		5	6		1	1	3	2	1			1	1
Feedbck	1		1			4	3	4	2	3	3					
Imp prdct design						1	1	1	1		3	2				
Senior org	4		2			1	1				2				1	
Prdct traing			2	2			2	3		1	6					
Publctn	5	1		1		2	1	1	1	5		2	3		1	
Purch mktg dec	6	2	3	3	7	8	4	2	9		1	6	2	4	2	3
Tailor cust																

Web tools										1						
Assist rule compl	1			1		1					1	2				
Buyers use	5	1	1		6	5	2	2	5			1	1	1	1	2
Dysfunc conseq																
No role cust perf						1	1	3		1	1					
No role finc perf																
No role perf	2			7		1	1	5	2	8	3		7	2	3	1
No role tech perf				1	2				1	3				2	1	
Re-des prdct impvd						1	1		2		1					
Role cust perf	1	2	1	1	1	3	4	2		3	3				1	
Role finc perf	3		1	2	6	4		2	2		1	3				2
Role perf	7	3	3	3	7	8	5	4	8	4	6	6	1	1	3	3
Role tech perf	2		2	1	1	4	1		5	1	3	3	1			1
Supplrs competv	3		1									4				
Tailord appropt																
Cplx Mkt										1	1	1				

Low cplx mkt																
Collab	3	1		1		1	1	1			1	1	1			1
Comm	3	1	3	2	2	2	1		3	1	2	8		2	1	1
Diff claims																
Rel role perf				1			1									
Soc xchange				2		1	1	2						1		

Code Occurrences by Respondent in Blood Glucose Meter Case

Data compiled from HyperResearch Report Function.

APPENDIX L

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Blood Glucose Meter Case

Influence	Respondents who Described Influence	Performance Measurement Predecessors	Performance Management Predecessors	Researcher Explanation
Product is purchased or not +/- F/C	Head Eval Centre, Tech Eval Leader, Cat Mangr Path, Pharm Serv Mangr PPD, Mangr Pt Care Test Team, DSN Found Trust, DSN PCT, Serv Devpt Mangr Pharcy, Direct Generl In-vitro Diag Assoc, Policy & Innov Director, Collab Devpt Mangr, Head R&D, NHS III Mangr	Clinicians assess with individual patients whether meter is appropriate for their needs. Other local level evaluation in Trusts. Communication and visits between customer and supplier. Technical evaluation by Evaluation Centre. National level assessment of costs, service package. Clinical studies, trials. Pharmacy assesses margins, technical aspects. PPD gathers information on product from supplier.	Use of performance measurement information such as clinician's assessments, evaluation centre outputs, information from the supplier. Making the purchasing decision, or decision to use, list or stock the meter or strips, resulting in eventual sales.	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare. Selection of a free meter will mean the patient then buys the strips for the meter, while decisions to list the meter on the NHS drug tariff and for sale in the pharmacy also enable sales of strips or meters to users to take place.
The best product for the needs of the user is purchased + C	DSN Found Trust, DSN PCT	DSN assesses with patient whether the meter or a competing product is most suitable for their needs.	Making with patient about which product to give them.	Assessment with patient enables the patient to choose their preferred meter from the options available to take away.
Performance measurement information is not involved in the purchasing decision None	Cat Spec Path, Head R&D, Serv Devpt Mangr Pharcy	Technical evaluation by Evaluation Centre.	Technical evaluation reports.	There is little use of information from the technical evaluation in the purchasing decision.
Supplier shows concern over performance measurement ***** +/- F	Head Eval Centre, Direct Generl In-vitro Diag Assoc	Technical evaluation by Evaluation Centre.	Technical evaluation outputs.	Reports are a good sales device for suppliers, or for competing suppliers. Suppliers have a good relationship with Eval Centre when results are good and vice versa.

Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not + T	Cat Mangr Path, Direct Generl In-vitro Diag Assoc, NHS III Mangr, Senr Mktg Mangr	Technical evaluation, clinical trials by supplier.	Checking the technical performance of the meter against promised & against regulations. Feedback to supplier. Making purchasing decision.	Performance measurement and management processes mean that the supplier knows the meter must perform as promised and to regulations it must meet if it is to be sold – IVD, CE marked.
CE marking does not necessarily signify a product that performs to a sufficient standard - F/T/C	Direct Care & Policy Diabetes UK, Direct Generl In-vitro Diag Assoc, Serv Devpt Mangr Pharcy	Assessment of technical performance of product during development of product by supplier. Information about product gathered by buyers, PPD before purchase or listing decision made.	Supplier puts CE mark on product. Buyers make decision to purchase the product on the basis of CE mark.	Although some respondents suggested processes help the meter meet standards and perform well, other respondents suggested that the standards are not a good guide to performance and a product that does not perform well may be bought on the basis of limited information.
Used to reduce product cost +/- F	Serv Devpt Mangr Pharcy, Pharm Serv Mangr PPD, Direct Generl In-vitro Diag Assoc	Measuring costs of strips prescribed on the NHS.	Negotiation between actors over % reduction in strip prices.	A % reduction in strip price on national drug tariff was negotiated and achieved on the basis of cost information measured by the NHS on a national level.
Product can be purchased or not for short-term, cost based rather than broader reasons - F/T/C	Policy & Innov Director, Collab Devpt Mangr, Head R&D, Pharm Serv Mangr PPD, DSN PCT	Assessing cost of blood glucose meter, evaluation and assessment of broader aspects of meter performance.	Purchasing, use decisions by DSNs with patients, PPD decision to list meter on NHS drug tariff.	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.

Compliance with use of the product is needed None	Head Eval Centre, Cat Spec Path, DSN PCT, Direct Care & Policy Diabetes UK, Senr Mktg Mangr Supplr	Assessment of which meter to use or buy with DSN.	Meter purchased, used by patient.	The meter can be bought, but if the patient does not use it or the patient does not act upon the blood glucose meter results given by the meter, it will have no benefit for their health.
Training is necessary for patient to gain benefits of product use + C	Cat Mangr Path, Senr Mktg Mangr Supplr, Mangr Pt Care Test Team, DSN PCT, Direct Care & Policy Diabetes UK	Clinical studies, technical and customer evaluations.	Training in use of the meter, as part of package provided by supplier, or provided by other local level users.	Users require training on the meter if they are to gain the correct results and be able to interpret them, benefitting their health.
Currently little evidence on the effectiveness of the healthcare procedure the product uses None	DSN PCT, Direct Care & Policy Diabetes UK	Clinical trials, technical evaluations.	Purchase, use of the meter.	There is currently limited evidence of the effectiveness of blood glucose testing as a discipline in gaining beneficial health outcomes, so effort in measuring and managing the performance of the meter may mean that a useless product is procured.
Product design improved + T	DSN Found Trust, Mangr Pt Care Test Team, Senr Mktg Mangr Supplr, Serv Devpt Mangr Pharcy	Assessing customer performance, customer forums.	Feedback to supplier, MHRA device alert, product innovation, free replacement.	The design of the blood glucose meter is permanently improved with a new display and hard locked scale.

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Blood Glucose Meter Case.

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).
Constructing the matrix: Cell entries are brief phrases highlighting roles coded in the case study and shown in the original large matrix of findings from respondents in the case. Processes with the influences, or implicit predecessors are shown. Intended outcomes or those that will occur are also shown (Miles & Huberman 1984 pp114-118). Only those influences that were seen in a pattern across more than one respondent in the code occurrences by respondent in the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response, guided by those in the summary matrices of findings for each case.

APPENDIX M
Matrix of Findings from Respondents in the ECG Monitor Case

Respondent / Research Question (RQ) Theme	**Performance Measurement** (RQs:A,C)	**Performance Management** (RQs:A,C)	**Performance Measurement/Performance Management Influence on Performance** (RQs:B,C)
Director, Evaluation Centre	Technical evaluation of value of ECG monitor for NHS use, by experts in laboratory.	Performance measurement information published, advice offered to purchasers in NHS.	Sales are affected by evaluation results. Supplier may ignore results, though evolution can occur following technical evaluations.
Category Manager Cardiology, NHS Supply Chain	Technical evaluations, assessment of ECG monitor against clinical criteria, lifetime costs are assessed.	Purchasing process and decision making, involving stakeholders. Publication in reports and case study.	Sales hindered by budget silos despite evidence of performance. Information use in purchasing varies.
Category Specialist Cardiology, NHS Supply Chain	Price, budget, lifetime costs are measured. Technical evaluation. Ease of use assessed. Information is shared between actors. Supplier demo to users.	Purchasing advice and information is given. Feedback given to suppliers. Making the decision to purchase the ECG monitor.	Information about performance is used to improve product. Performance data is of interest to competitors.
GP, GP Surgery	Tried ECG monitor on himself, assessed use for his cardiac interest and consulted colleagues. Asked for feedback by the supplier.	Decision making to use the ECG monitor. Supplier publication of performance information, audits performance of free monitors given to some users.	Uses the product having assessed performance of the meter. The product is a helpful clinical tool. Supplier sorted out product problems, improving performance.
Practice Nurse, GP Surgery	Assessed ease of use, cost and accuracy of ECG monitor. Supplier gave the surgery free product in return for feedback as part of supplier audit.	The supplier improves the design of the product. Supplier gathers feedback from audit involving the GP surgery.	A free upgrade to new version of the product with improved design features was given. Product purchased following assessment, would do so again.
CEO, Supplier	Cost of products and training to the NHS, comparing commodity versus high value items.	Clinical trial data used in promotion. Supplier visits clinician users to carry out training.	Evidence of product performance for sales through CPHs. The NHS is diverse locally, so costing difficult.
Chief Technology Officer, Supplier	Pre-production testing of product on users. Measurement of technical parameters to protocols, regulations and project measures as part of innovation.	Review of measures and taking product improvement actions as part of quality system, CAPA.	Performance information has improved product quality. Simple measurement and management processes add value, not complex ones.
Chief Technology Officer, Supplier, (2nd Interview)	Number of different evaluations of care pathway costs and of technical performance aspects focussing on accuracy. Clinical trial conducted by supplier. Supplier has been asked for information.	External audit of performance information for standards & MHRA. Performance measurement information included in reports, business case produced for GPs. CAPA system. Purchasing and trial purchase scheme.	Sales are made or not. Compliance with regulations achieved. Technical and customer performance has been improved by revised product design. Evaluation not dynamic like product so of limited use.
Policy & Innovation Director, NHS PASA	Technical Evaluation. Savings & line price models to measure financial performance of products. Broader value, of innovations sometimes measured.	Purchasing decision-making. Checking supplier's claims against results of technical evaluation, supplier challenged evaluation findings. Changes made to product design.	Processes do not currently have an influence as more proactive evidence of value needed, integrated into NHS.
Senior Collaborative Development Manager, NHS PASA	Clinical experts are consulted for their views. Stakeholder communication has been a key way of gathering information in setting up CPHs.	Decision-making about products to purchase by purchasers in the NHS.	Processes have limited influences as purchasing decisions are often made for other, short term reasons.
Head R&D, NHS PASA	Savings and budgets key, supplier KPIs. Performance measured to check supplier's evidence. Category staff specialists keep up with market & suppliers.	Decision-making about products to purchase by purchasers in the NHS. National level advice provided to local level purchasers by PASA staff. Trying to convince purchasers with evidence of performance.	Products are purchased without advice and information from performance measurement. It has been difficult to convince budget holder of evidence of technical performance, to pay and purchase product.
Senior Manager for Technology Introduction, NHS III	Assessment is made of the technical nature of product including patents, business plan of the supplier to exploit it.	III staff make the decision of whether to back a product financially.	Information gathered on a product and decision results in it being backed financially or not. Checking performance against regulations encourages the supplier to ensure product meets claims.

Summary Matrix of Key Findings Discovered in Coding in ECG Monitor Case (Cut 1: by respondent, cut 2: by theme in conceptual framework)

Method to Produce the Summary Table:
The table is a display format summarising the large amount of data from the original intra-case table that was produced from the respondent interviews coded using HyperResearch. The table is an un-ordered meta-matrix showing all the respondents in the case. The matrix is ordered by influence in the rows and conceptual framework theme in the columns, the latter determined by the research questions, as recommended by Miles & Huberman (1984 pp79-80).
The cells in the matrix show *"…short quote and summarising remarks…"* (Miles & Huberman 1984 p80) qualitatively describing the data coded in relation to the research questions in the original table. Code frequencies within the case are shown in a separate table. The qualitative remarks are produced following data reduction and weighting as suggested by Miles & Huberman. The latter was according to a decision rule where only findings relating to general codes that are matched by more than one respondent within the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Miles and Huberman (1984 pp104) advocated the following example, using the same method as in entering the data in the matrix here: *"…the data being entered in each cell are a brief summary of what the analyst found for each respondent in the field notes. The main decision rule appears to be this: if it's in the notes, summarise it and enter a phrase reflecting the summary."* Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response.
The research questions look at performance measurement and performance management processes. Performance measurement processes are also represented in the table by mention of the measures used, firstly for brevity, secondly because measurement procedures have been described as mapping and preserving the difference in a set of symbols and a collection of entities (Farbey *et al.* 1993 pp75-94), and finally because many respondents answered the questions about performance measurement processes by listing the measures that are used.

APPENDIX N
Code Occurrences by Respondents in the ECG Monitor Case

CODE	Director, Eval Centre	Cat Mangr, NHS Supply Chain	Cat Specst, NHS Supply Chain	GP	Practice Nurse	CEO, Supplr	CTO, Supplr	CTO, Supplr, (2nd)	Policy & Innov Director, PASA	Collab Devpt Mangr, PASA	Head R&D PASA	NHS III Mangr
Expt actors	1							1		2		1
Meas cust perf			2	5	2	1	1	3	1		3	2
Meas finc perf		4	2	1	1	1	1	2	3		1	2
Meas tech perf	11	7	5	9	2		7	14	9	1	6	5
Resorc								1				
Advice policy guid	7		6						1			
Check expctd	1	1	2		1		4	5	1		1	1
Feedbck	1	2	2	3	1			4	1			
Imp prdct design	1	1		2	2		4	8	1			
Senior org											1	
Prdct traing						2						
Publctn	5	2	1	2		1		5	3		3	
Purch mktg dec	8	5	3	5	1	1		5	2	4	3	3
Tailor cust												

Web tools								1				
Assist rule compl								1				1
Buyers use	6	2		2				3	1	1	1	2
Dysfunc conseq												
No role cust perf												1
No role finc perf		2				1	1		1			
No role perf	4		3			1	1	2	8	2	2	1
No role tech perf	4							1		2		
Re-des prdct impvd				1	2		1	7	1			
Role cust perf				3							1	
Role finc perf	4		1	1	1			3				2
Role perf	9	2	4	8	3	1	1	10	2	1	3	3
Role tech perf	6		2	4	2		1	7	2		1	1
Supplrs competv	2		1	1								
Tailord appropt												

Cplx Mkt												
Low cplx mkt												
Collab				1								1
Comm	2		6	3	1			1	1	2	1	1
Diff claims	3							2	2			
Rel role perf												
Soc xchange	2		1	1		1				1		

<u>Code Occurrences by Respondent in ECG Monitor Case</u>

Data compiled from HyperResearch Report Function.

APPENDIX O
Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the ECG Monitor Case

Influence	Respondents who Described Influence	Performance Measurement Predecessors	Performance Management Predecessors	Researcher Explanation
Product is purchased or not +/- F/C	Director Eval Centre, Cat Mangr, GP, CEO Supplr, CTO Supplr, Policy & Innov Director, Collab Devpt Mangr, Head R&D PASA, NHS III Mangr	Communication and visits between customer and supplier, GP calls colleague, tests device on himself, technical evaluation by Evaluation Centre, clinical trials.	GP makes decision to purchase the ECG monitor, Dissemination of technical evaluation information. Supplier try before you buy scheme, business case for GPs, distribution of performance data.	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare by offering a new care pathway, or remaining with the existing pathway if better. So far sales have been low.
Product design improved + T	GP, Practice Nurse, CTO Supplr, Policy & Innov Director PASA	Supplier trials product with GP surgeries, conducts clinical trial, communication between supplier and users.	Feedback to supplier, supplier innovates product.	The latest ECG Monitor comes with improved battery life, ability to interface with NHS patient records and automated connectivity checking to ensure electrodes are attached. Suppliers get better by evolution after technical evaluation. Teething problems also sorted by the supplier
Performance measurement information not used in the purchasing decision None	Director Eval Centre, Cat Mangr, Cat Specst, CTO Supplr, Head R&D PASA	Technical evaluation by Evaluation Centre.	Technical evaluation reports.	Information from the technical evaluation is not always used in the purchasing decision. Product well publicised but not bought. Easy for supplier to get overburdened with measurement procedures that do not add value.

Feedback to the supplier is not used None	Director Eval Centre, CTO Supplr	Technical evaluation by Evaluation Centre.	Technical evaluation reports, feedback to supplier.	The supplier ignores or does not use technical evaluation data as it is not dynamic.
Product can be purchased or not for short-term, cost based rather than broader reasons - F/T/C	Policy & Innov Director PASA, Collab Devpt Mangr, CEO Supplr, Head R&D PASA	Technical evaluation by Evaluation Centre, buyers. Clinical trial, other evaluations produced by supplier.	Purchasing decision making by buyers.	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers, hindering uptake. Budget silos. Difficult for supplier to cost training at varied local level.
Supplier shows concern over performance measurement ***** +/- F	Cat Specst NHS Supply Chain, GP, Director Eval Centre	Technical evaluation by Evaluation Centre.	Technical evaluation outputs.	Evaluation data is of interest to competitors. Evaluation Centre conclusions were not acceptable to supplier.
Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not + T	CTO Supplr, NHS III Mangr	Clinical trial by supplier. Supplier keeps technical records, quality manual. ISO notified body assesses supplier records.	Checking the technical performance of the meter against regulations. Making purchasing decision.	Performance measurement processes mean that the supplier knows the meter must perform to regulations, as policed by a notified body - ISO13485, MDD (42/93/EU).

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the ECG Monitor Case.

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).
Constructing the matrix: Cell entries are brief phrases highlighting influences coded in the case study and shown in the original large matrix of findings from respondents in the case. Processes with the influences, or implicit predecessors are shown. Intended outcomes or those that will occur are also shown (Miles & Huberman 1984 pp114-118). Only those influences that were seen in a pattern across more than one respondent in the code occurrences by respondent in the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response, guided by those in the summary matrices of findings for each case.

APPENDIX P
Matrix of Findings from Respondents in the Standing Frame Case

Respondent / Research Question (RQ) Theme	**Performance Measurement** (RQs:A,C)	**Performance Management** (RQs:A,C)	**Performance Measurement/Performance Management Influence on Performance** (RQs:B,C)
Research Director, Evaluation Centre	Technical evaluation by Evaluation Centre, also including user evaluation. Involves visits by supplier representatives.	Variety of publications produced using performance measurement information. Purchasing decision making. Feedback to supplier, making product changes.	Evaluation outputs assist purchasers and users of the frame, raises profile of the clinical area. Training and use of the frame are important if it is to perform for the child.
Centre Manager, Evaluation Centre	Technical evaluation of frames by Evaluation Centre, supplier visits during evaluation, which requires time and engineers. Sales data shared.	Variety of publications, web database produced using information from evaluation. Feedback given to supplier as part of evaluation process.	Suppliers care about evaluation process and results, suggesting it has an influence on performance. However evaluation outputs are late and may not be used.
Centre Manager, Evaluation Centre **/ Therapist**	Technical evaluation, assessing quantitative and qualitative aspects of technical and customer performance. Evaluation is resource intensive, supplier was involved and report drafts were shared.	Frame is individualised for the needs of a particular child using it. Reports are produced using performance measurement information. Feedback passed to and fro with supplier.	Frame design has been updated following feedback from the evaluation. However it is difficult to evaluate individual child needs effectively.
Lead Category Manager Assistive Technology / Special Projects, NHS PASA, DH	Evaluation of frame for clinical purpose. Cost and savings are key measures. Ad-hoc clinician feedback is used to learn about performance of the frame.	Publishing national level performance measurement data. Advice given to purchasers. Purchasing decision making.	Suppliers are sensitive to performance measurement outputs. Purchasing decisions are made on the basis of cost, limiting influence of processes measuring broader aspects of performance.
Category Specialist Mobility & Telecare, NHS PASA	User consultation by NHS PASA and suppliers. Product standards are researched with BHTA. Cost of product is measured with respect to annual budget.	Suppliers use feedback from users in making changes to product design, including for individual users. Advice given to purchasers.	Frame meets needs of user with changed design. Feedback must be used if it is to have an influence. Measures have a cost and may not always add value.
Paediatric Physiotherapist, Hospital NHS Foundation Trust 2	Therapists assess suitability of frame for individual child subjectively, with help of demonstration from supplier representative.	Therapist making decision to purchase frame. Producing funding justification letters. Supplier agreeing to sell product only if it is appropriate.	Frame has been purchased and benefits child following assessment and decision-making. However cost can prevent purchase of an appropriate product for child.
Paediatric Physiotherapist, PCT 2	Therapist assesses suitability of frame for needs of child using quantitative and qualitative techniques, supplier reps visit and work jointly with clinician.	Therapist purchasing decision making. Supplier customises and improves design of frame. Supplier does not push sales. Feedback to supplier during assessment.	Frame has been purchased. Design customised with headrest and straps. Split knee block available following feedback. Measurement aids compliance by user.
Physiotherapist, PCT 3	Therapist assesses frame for individual need of child and cost. Talking to supplier representatives, who also visit.	Therapist making purchasing decision. Supplier modification of old frame rather than sell new. Feedback to supplier. Evaluation report produced.	Frames have been purchased by the therapist for children, however cost can prevent some purchases. Child changes, making accurate measurement difficult.
Managing Director, Supplier	Clinical evidence of benefits of standing with frame. Cost of frame or surgery measured. User views of the frame are gathered. BHTA meets NHS PASA.	Report and funding justification documents produced. Feedback gathered is sent to head office. Making changes to product design by supplier.	Evaluation Centre evaluation had no conclusions so was no use. Therapist input is used to develop the product, if funding is available.
Director General, BHTA	Clinician assesses frame for clinical needs of a particular child. Cost and technical aspects of frame performance are measured.	Checking performance measures against standards. Tailoring the product design to the needs of a particular child. Improving the basic product design.	Purchasing decisions made on basis of performance measurement information. Tailored frame benefits child. Frame meets technical criteria.
Chair Seat Divis, BHTA	Technical evaluation, assessment of clinical benefits. Financial measurement of longevity & warranties. Two way flow of information and visits between suppliers, BHTA and CEP.	Dissemination of technical evaluation data. Purchasing decision making by NHS purchasers. Making changes to the design of the product.	Performance measurement outputs affect the purchasing decision and have an influence on sales of the standing frame. Suppliers change products to gain an edge over competitors.
Policy & Innovation Director, NHS PASA	Savings & line price models to measure financial performance of products. Broader value, of innovations sometimes measured.	Purchasing decision-making. Evaluation Centre publication outputs to evaluations.	Processes do not currently have an influence as more proactive evidence of value needed, integrated into NHS. *Continued overleaf*

Senior Collaborative Development Manager, NHS PASA	Clinical experts are consulted for their views. Stakeholder communication has been a key way of gathering information in setting up CPHs.	Decision-making about products to purchase by purchasers in the NHS.	Processes have limited influences as purchasing decisions are often made for other, short term reasons.
Head R&D, NHS PASA	Savings and budgets key, total costs, supplier KPIs. Category staff specialists keep up with market & suppliers	Decision-making about products to purchase by purchasers in the NHS. National level advice provided to local level purchasers by PASA staff.	Products are purchased without advice and information from performance measurement. Although evidence of technical performance may exist, budget holder still has to be convinced to pay if product is to be purchased.
Senior Manager for Technology Introduction, NHS III	Assessment is made of the technical nature of product including patents, business plan of the supplier to exploit it.	III staff make the decision of whether to back a product financially.	Information gathered on a product and decision results in it being backed financially or not. Checking performance against regulations encourages the supplier to ensure product meets claims.

Summary Matrix of Key Findings Discovered in Coding in Standing Frame Case (Cut 1: by respondent, cut 2: by theme in conceptual framework)

Method to Produce the Summary Table:

The table is a display format summarising the large amount of data from the original intra-case table that was produced from the respondent interviews coded using HyperResearch. The table is an un-ordered meta-matrix showing all the respondents in the case. The matrix is ordered by role in the rows and conceptual framework theme in the columns, the latter determined by the research questions, as recommended by Miles & Huberman (1984 pp79-80).

The cells in the matrix show *"…short quote and summarising remarks…"* (Miles & Huberman 1984 p80) qualitatively describing the data coded in relation to the research questions in the original table. Code frequencies within the case are shown in a separate table. The qualitative remarks are produced following data reduction and weighting as suggested by Miles & Huberman. The latter was according to a decision rule where only findings relating to general codes that are matched by more than one respondent within the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Miles and Huberman (1984 pp104) advocated the following example, using the same method as in entering the data in the matrix here: *"…the data being entered in each cell are a brief summary of what the analyst found for each respondent in the field notes. The main decision rule appears to be this: if it's in the notes, summarise it and enter a phrase reflecting the summary."* Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response.

The research questions look at performance measurement and performance management processes. Performance measurement processes are also represented in the table by mention of the measures used, firstly for brevity, secondly because measurement procedures have been described as mapping and preserving the difference in a set of symbols and a collection of entities (Farbey *et al.* 1993 pp75-94), and finally because many respondents answered the questions about performance measurement processes by listing the measures that are used.

APPENDIX Q
Code Occurrences by Respondents in the Standing Frame Case

CODE	Resrch Dirctr, Eval Centre	Centre Mngr, Eval Centre	Centre Mangr, Eval Centre / Therapist	Lead Cat Mangr, Assist Tech	Cat Speclst, Mobility	Paed Physio, Found Trust	Paed Physio, PCT	Physio, PCT 2	MD, Supplr	Direc General, BHTA	Chair Seat Divis, BHTA	Policy & Innov Director, PASA	Collab Devpt Mangr, PASA	Head R&D PASA	NHS III Mangr
Expt actors		1	1				1				2		2		1
Meas cust perf	1	4	2	2	4	14	19	11	4	1		1		3	2
Meas finc perf		1	1	4	1	2	1	2	3	2	2	3		2	2
Meas tech perf	8	5	8	2	2	1	9	6	14	5	3	6	1	3	5
Resorc	1	2	2		1	1	1		1	1					
Advice policy guid				1								1		1	
Check expctd		1	1	1						3				1	1
Feedbck	1	2	6	2	2	1	3	1	5		2				
Imp prdct design	2		4		1		2		5		2				
Senior org									1		1			1	
Prdct traing	1	3													
Publctn	4	2	8	3		3	2	1	5			3		1	
Purch mktg dec	1	1	2	4		10	3	4	1	1	2	2	4	2	3
Tailor cust			2		1		4			1					

Web tools	1	3	2	1			1		1						
Assist rule compl	1									2	1				
Buyers use			1	2		7	2	5		1	2	1	1	1	2
Dysfunc conseq				1					1						
No role cust perf	1	1				1	1	3							1
No role finc perf				1		1									
No role perf	1	2	1	2	1	2	2	3	8			7	2	1	1
No role tech perf		1					1		5				2		
Re-des prdct impvd					1		1								
Role cust perf	1	2		1	3	4	6	2		1				1	
Role finc perf	1	1	1	4	1	1			1	1	3				2
Role perf	4	5	4	5	4	7	8	4	3	4	5	1	1	3	3
Role tech perf	1	1	2		1	1	2	2	2	2	2	1		1	1
Supplrs competv	1	2		2							1				
Tailord appropt					1		2			1					
Cplx Mkt															

Low cplx mkt				2		1	1			1					
Collab	1	1	1			1	3	1							1
Comm		2	2	5	1	1	1	2	1		2		2	1	1
Diff claims															
Rel role perf			1												
Soc xchange	1	4	1			3	3	2	4		1		1		

Code Occurrences by Respondent in Standing Frame Case

Data compiled from HyperResearch Report Function.

APPENDIX R

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Standing Frame Case

Influence	Respondents who Described Influence	Performance Measurement Predecessors	Performance Management Predecessors	Researcher Explanation
Product is purchased or not +/-	Centre Mangr Eval Centre / Therapist, Lead Cat Mangr Assist Tech, Paed Physio Found Trust, Paed Physio PCT, Physio PCT 2, Direc General BHTA, Chair Seat Divis BHTA, Policy & Innov Director, Collab Devpt Mangr, Head R&D, NHS III Mangr	Therapists assess performance of the standing frame for the particular needs of the child concerned. Communication and visits between customer and supplier. Technical evaluation by Evaluation Centre.	Use of performance measurement information such as therapist's assessments, evaluation centre outputs. Making the purchasing decision. Marketing the scanner to the customer, producing funding justification.	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer the benefit of a product that performs best for healthcare by offering a new care pathway. So far sales have been low.
The best product for the needs of the user is purchased +	Cat Speclst Mobility, Paed Physio Found Trust, Paed Physio PCT, Direc General BHTA	Therapists assess performance of the standing frame for the particular needs of the child concerned, with supplier. Communication and visits between customer and supplier. Technical evaluation by Evaluation Centre.	Use of performance measurement information such as therapist's assessments, evaluation centre outputs. Making the purchasing decision.	The performance information used and the process of making the purchasing decision gives a particular child the best standing frame for their individual needs.
Product meets needs of individual user as it has been customised with special features for the particular purchase +	Paed Physio PCT, Cat Specialist, Direc General BHTA	Therapists assess performance of the standing frame for the particular needs of the child concerned, with supplier. Communication and visits between customer and supplier.	Supplier tailors frame features for a particular child.	Supplier customises the frame with features such as alternative headrests and straps to tailor it to meet the needs of a particular child.
Product can be purchased or not for short-term, cost based rather than broader reasons -	Lead Cat Mangr Assist Tech, Paed Physio Found Trust, Paed Physio PCT, Physio PCT 2, Policy & Innov Director PASA, Collab Devpt Mangr PASA, Head R&D PASA	Purchasing decision makers assess cost of standing frame, especially on national level of NHS.	Purchasing decision making by NHS actors.	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.

Information not used in the purchasing decision None	Centre Mngr Eval Centre, Centre Mangr Eval Centre / Therapist, Physio PCT 2, MD Supplr, Direc General BHTA, Policy & Innov Director, Collab Devpt Mangr, Head R&D	Technical evaluation by Evaluation Centre, assessment of frame for needs of child by therapists.	Technical evaluation outputs. Purchasing decision by buyer.	Information from performance measurement and management processes is not used in the purchasing decision. The product may be bought for all sorts of reasons other than on the basis of performance measurement information. Technical evaluation outputs may be late, not prescriptive enough. Assessing the frame for children’s diverse and changing needs is challenging.
Product design improved +	Resrch Dirctr Eval Centre, Centre Mangr Eval Centre / Therapist, Paed Physio PCT, Chair Seat Divis BHTA	Communication between supplier representatives and users. Technical evaluation by Evaluation Centre.	Feedback to supplier, supplier makes design changes.	The design of the standing frame has been permanently improved, for example through new split knee blocks in response to user feedback.
Feedback to the supplier is not used None	Cat Speclst Mobility, Physio PCT 2	Communication between users and supplier, technical evaluation by Evaluation Centre.	Feedback to supplier, supplier makes design changes to product.	If feedback of performance measurement information to the supplier is not used proactively, it will not have an influence on performance.
Compliance with use of the product is needed None	Resrch Dirctr Eval Centre, Paed Physio PCT	Therapist assesses with child and carers whether the standing frame is appropriate for particular needs.	Standing frame purchased, used by patient.	If the standing frame is to perform for a child and be effective in aiding their health, it must be used once purchased.
Training is necessary for patient to gain benefits of product use +	Resrch Dirctr, Centr Mangr Eval Centre	Communication between users and supplier.	Standing frame purchased, training in use, used.	Training of users is important if the standing frame is to be used correctly and the child is to gain the healthcare benefits of using the frame.

Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not +	Lead Cat Mangr Assist Tech, Direc General BHTA, Chair Seat Divis BHTA, NHS III Mangr, Head R&D	Technical evaluation by Evaluation Centre. Supplier designs product to technical specification.	Supplier and Evaluation Centre check product meets regulations. Feedback to supplier. Making purchasing decision.	Checking performance against regulations mean that the supplier know and ensure that the product must meet a certain standard. Evaluation by the customer encourages the supplier to ensure the frame performs as they claim.
Supplier shows concern over performance measurement ***** +/-	Resrch Dirctr Eval Centre, Centre Mngr Eval Centre, Lead Cat Mangr Assist Tech, Chair Seat Divis BHTA	Technical evaluation by Evaluation Centre.	Technical evaluation outputs.	Suppliers show concern that performance measurement data will affect their competitive position or sales. Supplier use evaluation information to make their product more competitive compared to others Technical evaluation raises the profile of assistive technology and organisations involved.

Effects Matrix Showing Influences of Performance Measurement and Performance Management Processes, as Described by Respondents in the Standing Frame Case.

(**KEY:** '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).
Constructing the matrix: Cell entries are brief phrases highlighting influences coded in the case study and shown in the original large matrix of findings from respondents in the case. Processes with the influences, or implicit predecessors are shown. Intended outcomes or those that will occur are also shown (Miles & Huberman 1984 pp114-118). Only those influences that were seen in a pattern across more than one respondent in the code occurrences by respondent in the case are included, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response, guided by those in the summary matrices of findings for each case.

APPENDIX S
Matrix of Findings Across the Four Case Studies

Case / Research Question (RQ) Theme	**Performance Measurement** (RQs:A,C)	**Performance Management** (RQs:A,C)	**Performance Measurement/Performance Management Influence on Performance** (RQs:B,C)
CT Scanner	**Financial**: Purchase and maintenance costs are measured. **Technical**: Technical evaluation and measurement of technical aspects of performance. **Customer**: Clinicians in Trust assess if scanner package meets their clinical needs and functionality for Trust. Actors gather and survey user opinions. Site visits are made, clinicians talk to current users, demonstrations are given, clinicians try using the scanner, supplier learns about purchaser's needs.	**Information Dissemination**: Technical evaluation reports and tools produced using information from performance measurement. Feedback of performance information to supplier. Supplier trains scanner users. **Purchasing**: Trust purchasing tender process including scoring, ranking, decision making. **Product innovation**: Supplier customises scanner package to Trust needs and continually makes changes to improve scanner software design.	**Influence on financial performance**: Scanner bought or not. Purchasing decisions may be influenced by other, local reasons than performance measurement information. Technical evaluation reports may be used but also may not be used as they are late and clinicians have knowledge already. Suppliers are concerned about technical evaluation results, suggesting they affect sales. **Influence on technical Performance**: Software has been re-engineered and radiation dose reduced. Performance measurement data has assisted maintenance, getting supplier to make repairs. **Influence on customer performance**: Scanners purchased are suitable for Trust needs.
Blood Glucose Meter	**Financial**: Sales and trends measured by supplier. Strip price and % reduction discussed. **Technical**: Technical evaluation and measurement of technical aspects of performance, of accuracy, reliability for example, requires a lot of resources. Quality assurance testing of technical aspects of performance. Trials conducted by supplier. **Customer**: DSN subjectively assesses product suitability with individual patient for their particular clinical needs, looking at ease of use for example. Service package measured nationally. User forums are conducted. Communication and information sharing between actors.	**Information Dissemination**: Evaluation Centre publications using performance measurement information. Feedback of information on product performance to supplier. Supplier educates users, offers advice and help lines. **Purchasing**: DSN chooses meter with patient. PPD evaluates strip for inclusion on drug tariff. Pharmacy actors decide to stock meter for sale. **Product innovation**: MHRA referral, recalling, re-designing and replacing the meter.	**Influence on financial performance**: The meter is given or bought and then strips are bought. Drug tariff and IVD approval enables prescription and purchase. Pharmacy decided to stock meter for sale. Many purchasers use reports. 12% cut in strip price occurred. **Influence on technical performance**: The meter display and scale have been improved. **Influence on customer performance**: More evidence of blood glucose testing benefits is needed. Little follow up action is taken after testing. Training benefits users.
ECG Monitor	**Financial**: Lifetime costs, costs of care pathways are evaluated. **Technical**: Technical evaluation of clinical criteria, accuracy, ease of use and supplier claims. Supplier conducted pre-production tests, clinical trial, uses innovation project measures. **Customer**: GP tried product on self, assessed use for own clinical interest. Supplier demo to users, discussion & gathers feedback.	**Information Dissemination**: Report production. Advice to buyers. Supplier offers training. **Purchasing**: Decision making by purchaser. A business case is produced for GPs. Trial purchase scheme. Clinical trial data is used in promotion. External technical audit of measurement information for MHRA. **Product innovation**: Supplier operates quality system including CAPA, product design changes are made. GPs are also involved in a supplier audit.	**Influence on financial performance**: Monitor is bought or not. Compliance with regulations is needed for sales to occur. Evaluation Centre evaluation was not dynamic so of little use. Purchasing decisions are often made for short-term reasons. Limited broad performance measurement information, integrated into NHS at local level, advice or data not used. **Influence on technical performance**: Monitor has improved interface with NHS records system, connectivity, battery life. *Continued overleaf*

Standing Frame	**Financial**: Cost and budget are measured on national level. **Technical**: Technical evaluation, also including user evaluation. Evidence of clinical benefits is scarce and being investigated. **Customer**: Therapists assess suitability of frame for individual child, a mainly subjective process. Supplier reps visit clinicians with product to assess suitability for the clinical needs of a particular child. Communication between actors.	**Information Dissemination**: Evaluation Centre publications, database tool produced. Feedback of measurement information to supplier. Advice given to buyers. **Purchasing**: Therapist making buying decision. **Product innovation**: Making changes in product design by supplier with new split knee blocks. Supplier customises frame to individual child, by adding head rest, straps for example.	**Influence on financial performance**: Frame bought or not, is compliant with regulations. However short-term reasons and cost influence buying as well as measurement outputs. Mixed use is made of reports, which may be late, inconclusive limiting their influence. Suppliers are sensitive to evaluation suggesting it affects sales. **Influence on technical performance**: Frame design has been improved with split knee block. Feedback must be used if technical changes are to be made. **Influence on customer performance**: Frame that is most appropriate for a particular child is bought. Compliance in use needed if product is to perform for user.

Summary Matrix of Key Cross Case Findings Discovered in Coding (Cut 1: by case, cut 2: by theme in conceptual framework)

Method to Produce the Summary Table:

The table is a display format summarising the large amount of data from each of the four intra-case summary matrices. The table is an un-ordered meta-matrix showing all the cases in the empirical work. The matrix is ordered by case in the rows and conceptual framework theme in the columns, the latter determined by the research questions, as recommended by Miles & Huberman (1984 pp79-80).

The cells in the matrix show *"…short quote and summarising remarks…"* (Miles & Huberman 1984 p80) qualitatively describing the data coded in relation to the research questions in the intra-case tables. Code frequencies across the four cases are shown in a separate table. The qualitative remarks are produced following data reduction and prioritising high frequency codes and concepts across the respondents in each case, in accordance with the pattern matching analytic strategy used (Yin 2003 pp116-120). Given the large amount of data to be reduced into this matrix, the process has where necessary involved what Miles and Huberman refer to as standardisation of cell entries to a more generic descriptor and taking the modal response.

APPENDIX T
Code Occurrences by Case

Research Question Area	CODE	Multi-slice CT Scanner Case		Blood Glucose Meter Case		ECG Monitor Case		Standing Frame Case	
		Total instances of code in case	*No respondents mentioned code* (of 16)	*Total instances of code in case*	*No respondents mentioned code* (of 16)	*Total instances of code in case*	*No respondents mentioned code* (of 12)	*Total instances of code in case*	*No respondents mentioned code* (of 15)
A: How are processes used to measure and manage the performance of innovative healthcare products during their implementation? **C**: How can performance measurement and performance management processes during the implementation of innovative healthcare products be differentiated?	Expt actors	13	8	6	5	5	4	8	6
	Meas cust perf	71	14	49	12	20	9	68	13
	Meas finc perf	38	11	35	12	18	10	26	13
	Meas tech perf	118	16	88	16	76	11	79	15
	Resorc	6	3	5	4	1	1	10	8
	Comm	25	13	32	14	18	9	21	12
	Soc xchange	30	12	7	5	6	5	20	9
	Advice policy guid	8	5	16	8	14	3	3	3
	Check expctd	30	11	24	10	17	9	8	6
	Feedbck	32	10	21	8	14	7	25	10
	Imp prdct design	12	7	9	6	19	7	16	6
	Senior org	3	3	11	6	1	1	3	3
	Prdct traing	6	3	16	6	2	1	4	2
	Publctn	27	7	23	11	22	8	32	10
	Purch mktg dec	92	14	62	15	40	11	40	14
	Tailor cust	13	8	-	-	-	-	8	4
	Web tools	8	3	1	1	1	1	9	6

Continued overleaf

B: How do the processes used to measure and manage the performance of innovative healthcare products during their implementation influence their performance? **C**: How can performance measurement and performance management processes during the implementation of innovative healthcare products be differentiated?	Assist rule compl	2	2	6	5	2	2	4	3
	Buyers use	58	14	33	13	18	8	25	11
	Dysfunc conseq	10	8	-	-	-	-	2	2
	No role cust perf	2	2	7	5	1	1	8	6
	No role finc perf	2	2	-	-	5	4	2	2
	No role perf	32	13	42	12	24	9	33	13
	No role tech perf	7	4	10	6	7	3	9	4
	Re-des prdct impvd	8	4	5	4	12	5	2	2
	Role cust perf	26	9	22	11	4	2	21	9
	Role finc perf	26	9	26	10	13	6	16	10
	Role perf	91	15	72	16	47	12	61	15
	Role tech perf	35	12	25	12	26	9	19	13
	Supplrs competv	12	5	8	3	4	3	6	4
	Tailord appropt	2	2	-	-	-	-	4	3

Code Occurrences by Case

Data compiled from HyperResearch Report Function

APPENDIX U

Effects Matrix Showing the Influences of Performance Measurement and Performance Management Processes as Mentioned by Respondents and Cross Case Patterns

Influence	Cases Where Found				Performance Measurement Predecessors	Performance Management Predecessors	Researcher Explanation
	CT	BGM	ECG	SF			
Product is purchased or not +/- F/C	**Y**	**Y**	**Y**	**Y**	Actors measure various aspects of product performance.	Use of performance information from measurement in making a purchasing decision. Supplier markets product to customer.	The decision to purchase the product or not on the basis of performance measurement information gives the supplier sales or not and the customer Trust the benefit of a product that performs best for healthcare.
The best product for the needs of the user is purchased + C	**Y**	**Y**	**N**	**Y**	Actors measure various aspects of product performance.	Use of performance information from measurement in making a purchasing decision.	The best product for the needs of the Trust or patient user is purchased when performance of the product and any competing products is measured and this information used to make a purchasing decision.
Product can be purchased or not for short-term, cost based rather than broader reasons - F/T/C	**Y**	**Y**	**Y**	**Y**	Actors measure cost aspects of product performance.	Use of performance information from measurement in making a purchasing decision.	The product is bought or not in a decision made on the basis of cost performance measurement information with a short term view. Evidence of broader aspects of performance is not used proactively or integrated back to buyers.

Continued overleaf

Performance measurement information not used in the purchasing decision None	**Y**	**Y**	**Y**	**Y**	Actors measure various aspects of product performance.	Dissemination of information from performance measurement.	Information from performance measurement and management processes is not used in the purchasing decision. The product may be bought for all sorts of reasons other than on the basis of performance measurement information.
Product design improved + T	**Y**	**Y**	**Y**	**Y**	Actors measure various aspects of product performance.	Feedback to supplier. Product innovation by supplier.	The design of the product is permanently improved.
Feedback to the supplier is not used None	**Y**	**N**	**Y**	**Y**	Actors measure various aspects of product performance.	Feedback to the supplier.	Feedback on performance measurement information given to the supplier is not used.
Used in acceptance testing + T	**Y**	**N**	**N**	**N**	Actors measure various aspects of product performance.	Use of performance information from measurement in making a purchasing decision. Dissemination of information from performance measurement. Checking performance of the product against specification.	Performance measurement outputs are used to ensure the product meets the promised specification when it arrives at the supplier, before being accepted and paid for.
Useful for repairs + T	**Y**	**N**	**N**	**N**	Technical evaluation by Evaluation Centre.	Checking of scanner performance against expected.	Customer's own performance data makes the case to the supplier to come and make repairs to the scanner. *Continued overleaf*

Supplier ensures product performs to their specification & regulations, as it will be tested and then purchased or not + T	**Y**	**Y**	**Y**	**Y**	Technical evaluation by Evaluation Centre.	Checking performance of product against claims. Feedback to supplier. Use of performance information from measurement in making a purchasing decision.	Performance measurement and management processes mean that the supplier know and ensure that the product must meet a certain standard.
Supplier shows concern over performance measurement* +/- F	**Y**	**Y**	**Y**	**Y**	Actors measure technical aspects of product performance.	Dissemination of information from performance measurement.	Suppliers show concern that performance measurement data will affect their competitive position or sales.
CE marking does not necessarily signify a product that performs to a sufficient standard - F/T/C	**N**	**Y**	**N**	**N**	Assessment of technical performance of product during development of product by supplier. Information about product gathered by buyers, PPD before purchase or listing decision made.	Supplier puts CE mark on product. Buyers make decision to purchase the product on the basis of CE mark.	Although some respondents suggested processes help the meter meet standards and perform well, other respondents suggested that the standards are not a good guide to performance and a product that does not perform well may be bought on the basis of limited information.
Used to reduce product cost +/- F	**N**	**Y**	**N**	**N**	Customer measures cost performance of product.	Negotiation between customer and supplier over % reduction in cost of product.	A % reduction in product price was negotiated and achieved on the basis of cost information measured by the customer. *Continued overleaf*

Compliance with use of the product is needed None	**N**	**Y**	**N**	**Y**	Actors measure various aspects of product performance.	Decision made to purchase product, product is used or not.	The product may be purchased, but if the patient does not use it or take any necessary follow up healthcare measures, it will not have a benefit for their health.
Training is necessary for patient to gain benefits of product use + C	**N**	**Y**	**N**	**Y**	Actors measure various aspects of product performance.	Training in use of the product.	Users require training in use of the product if they are to use it properly, benefitting their health.
Currently little evidence on the effectiveness of the healthcare procedure the product is part of None	**N**	**Y**	**N**	**N**	Actors measure technical aspects of product performance.	Purchase, use of the product.	If there is currently limited evidence of the effectiveness of the healthcare procedure the product uses in gaining beneficial health outcomes, so effort in measuring and managing the performance of the product may mean that a useless product is procured.
Product meets needs of individual user as it has been customised with special features for the particular purchase + C	**N**	**N**	**N**	**Y**	Actors measure customer aspects of product performance.	Supplier tailors product features for a particular child.	Supplier customises the product with different features such as alternative headrests and additional straps to tailor it to meet the needs of a particular child.

Effects Matrix Showing the Influences of Performance Measurement and Performance Management Processes as Mentioned by Respondents and Cross Case Patterns.

(**KEY:** 'Y'=Yes, influence found in case, 'N'= No, influence not found in the case. '+' is a beneficial influence, '-' is a non-beneficial influence. 'F' is an influence on Financial performance, 'T' is an influence on Technical performance and 'C' is an influence on Customer performance (After Griffin & Page 1996). 'None' means there is no influence on performance. '*' denotes an influence inferred by researcher rather than specifically described by respondent).

Constructing the matrix: The matrix is compiled from the findings in the intra-case effects matrices showing influences of performance measurement and performance management processes.